THE

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Vol. LXI.] CONTENTS: August 30, 1907. [No. 1,553.

	Page
A Moral Code for Engineers	325
Sky Sign Legislation	326
Influence of Wave Form on Efficiency	327
Boiler Performances	327
A Testing Switchboard (*illus.*)	328
The Draft Regulations of the Home Office	329
New Electrical Devices, Fittings and Plant (*illus.*)	331
The British Association Meeting at Leicester:—	
On the Pupin Mode of Working Trunk Telephone Lines (*illus.*)	331
The Arc and the Spark in Radio-Telegraphy	334
Correspondence:—	
Proposed Electrical Exhibition in Manchester	335
"Cutting"	336
Records and Drawings of Electric Mains	336
Electric Winches	337
Lightning Conductors	337
Electricity Supply Accounts	337
The Training of Young Engineers	338
Public Lighting Statistics	339
Business Notes	339
An Electric Installation at Leeds (*illus.*)	343
A New Motor-Generator Set (*illus.*)	346
Notes	350
City Notes	353
Electric Tramway and Railway Traffic Returns	354
Stocks and Shares	354
Share List of Electrical Companies	355
Exports and Imports of Electrical Goods during July, 1907	357
Reviews	358
Electrical Driving in American Newspaper and Printing Offices	3 0
A New Method of Winding Alternator Coils (*illus.*)	361
Review of the L.G.B. Departmental Committee's Report relating to Electricity Supply Undertakings.—III.	361
Methods of Securing Power Business	362
The Junior Institution of Engineers	363
New Patents Applied For, 1907	364
Published Specifications	364

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A MORAL CODE FOR ENGINEERS.

To the *Electrical World* of New York we are indebted for the text of a report presented to the American Institute of Electrical Engineers by Dr. S. S. Wheeler, Dr. C. P. Steinmetz, and Mr. H. W. Buck, together with an appreciative editorial. Our esteemed contemporary says:—"No honest man can, or ever could, accept a commission at the expense of his clients; and yet, so loose has the ordinary business morality become, that the 'rake-off' is the engineer's greatest temptation, and the one oftenest excused by disingenuous arguments. We should like to see this practice made a penal offence, punishable with prison stripes."

Well, so it is, in this country now; and has been ever since January 1st of this year, and in certain forms it has, for some hundreds of years, been a criminal offence to levy blackmail, or to take bribes.

The only convictions so far, under the new Act, are those of a clerk at a Manchester warehouse who gave threepence to a carter in the employ of a railway company to carry a parcel to another warehouse in the City, and a warehouse labourer in London who did exactly the same thing a few days ago. The clerk was let off with a heavy fine on the ground that this was the first conviction under the new Act. We wish it were possible to presume from this fact that secret commissions have died out. We fear they have only become more secret.

In view of the strict laws against bribery and corruption which exist in almost every country, it seems fairly clear that the state of public opinion is the sole index to the differences which mark the different nations in this respect. For instance, we are informed that the laws against corruption are more severe in Russia than in England, but everybody knows that Russia is one of the most corrupt Empires that still survives—albeit with difficulty—on the face of the earth. We welcome, therefore, every attempt to form public opinion, and especially engineering opinion, on this great question, as it seems the only way to effect any improvement.

These rules laid before the American Institute of Electrical Engineers are steps in the right direction. If they err, it is by being too comprehensive. Such a code of rules should, in our opinion, be confined strictly to penalising improper conduct, and a breach of any one of them should immediately be followed by expulsion from the Society. The first five rules under the heading "General Principles," are almost too general to be practically applied; and certainly many of the rules which refer to matters other than actual misconduct could not possibly be enforced in this way.

They lay it down that the engineer should hold himself responsible for the enterprises he takes in hand, and the persons with whom he is associated.

The effect of such a rule depends upon the interpretation. Some men might say that an electrical engineer would

have to refuse to install the electric light in the house of a man of whose character he disapproved.

Again, the engineer is to take care that the credit of any improvement is given to the real author.

Unfortunately, this is just one of those things which distinguish great men from the majority. Men who are scrupulous about such matters belong to the "Salt of the Earth."

Again, the engineer is to aim consistently at standardisation. Most of our consulting engineers have spent the greater part of their lives in efforts the very opposite of this. But we are glad to acknowledge the change that is coming in our own country as the result of the labours of the Engineering Standards Committee.

It is worthy of note that most of the rules are framed for consulting engineers. But, as a matter of fact, consulting engineers only form a small minority in any of our great institutions, a fact they seem apt to forget. Thus engineers are enjoined not to be financially interested in patents with which they have to deal, except on explaining the matter to the client and getting his sanction. But the great Institutions and Societies should adopt a more reasonable attitude towards those of their members who are patentees but not consultants or Government servants. It should be frankly recognised that manufacturers are practically compelled by competition to protect their inventions; and they should be encouraged—not discouraged, as at present—in putting forward for discussion the subject matter of patented inventions. At the present day there is a fiction cherished by some of our engineering institutions that no member is supposed to protect his ideas from his fellow members and the public. But, as everyone knows, this is simply sham and hypocrisy; and the only effect of preventing members from referring to patents in their communications is that the members are misled into thinking that they are free to adopt the processes or devices described without paying royalty.

Under the American rules it is laid down that no engineer should work for two rival concerns at the same time; and that information and designs furnished to a consultant by one client should not be used for the benefit of another client—a rule with which we quite agree, though we doubt if there is any good rule more often broken.

Another rule says that controversies on engineering matters should always be carried on in the technical Press, and in societies, and not in the public Press.

Expert witnesses are not to take sides, and they are to avoid bias. We fear they will suffer extinction on the day when they become truthful and impartial.

The relations of the engineer to the engineering fraternity are next discussed. He is to show interest in his technical society, and to assist his brethren by interchange of information and otherwise. He must not take a position left by another engineer without satisfying himself that the latter had left it voluntarily or for proper reasons. When we can get well past the "starving wolf" stage of civilisation, it will be time to talk of boycotting vacancies when they occur unfairly.

Under another rule, an attempt is made to distinguish between "electrical engineers" and "electricians"—in other words, between professional men and workmen. We fear this, too, is impossible, and that the only available course is to distinguish by ability and fitness, between members of the Institution and all outsiders, so as to make the membership the "hall-mark" of the profession.

But the time has arrived when those members who are engaged in actual construction and manufacture should claim their full rights in all our great Institutions and take their proper share in their control. The success of the Institution of Mechanical Engineers, and the popularity of its management with the members, are largely due to the entire absence of the old-fashioned and quite false idea that the man who draws a fee for supervising and inspecting is, in some mysterious way, superior to the man who executes the work; quite often the man who makes, is also the man who designs, and he is beginning to insist upon proper recognition. To come back to the most important point of all, he is the man who has to pay the illicit commission, or blackmail (or to lose his order by refusing), when such is expected by an unworthy advising engineer; and he may be depended upon to make fierce war against such evils as soon as he feels his power.

When all is said and done, the rules are all embodied in the standard of conduct of every honourable man, and are printed deep in his heart and conscience. To be scrupulous in all things, upright and fearless, and to decide always upon the merits, these are the principles that become habits, and distinguish, quite as much as ability and success, the great engineer.

Sky-Sign Legislation.

The amount of solicitude for other people's finer feelings which is lying around loose at the present day would be extremely touching, if it were not so appalling. It is a long time since the phrase "Grandmotherly Legislation" was invented, and from all appearances the grandmother is not growing wiser as she grows older. The wise men of this country have lately been considering a Bill which is an excellent illustration of the way in which special and careful means are taken effectually to strangle enterprise in the course of pursuing to an absurd conclusion a mistaken notion of æsthetics. It will be remembered that some time ago an Act was passed for the County of London, whereby it was rendered impossible for a sign to be placed against the sky; that is to say, a sign, if erected on the roof of a building, was not to stand more than 3 ft. above the level of the roof, and it was to be boarded at the back so that no object could be seen through the lettering, unless a special licence were obtained. This Act is still in force in the County of London, and has effectually prevented the placing of electric signs in many prominent and effective positions. Judging from the Bill under consideration, the æsthetic sensibilities of those in authority must have been extremely gratified, for it is now proposed to extend the same legislation over the whole country at the option of any municipality or local authority which chooses to include a by-law to this effect in its rules and regulations. Judging from the usual eagerness of municipalities to include any idea in their by-laws which gives them an increase of authority over private enterprise, it is highly probable that the law, if passed, will effectually crush the development of a new and important branch of the supply of electricity from central stations.

The provisions which seem to require modification are:—"It shall not be lawful to erect or fix to, upon, or in connection with any building or erection any sky sign, and it shall not be lawful to retain any existing sky sign so erected or fixed for a longer period than three years after the passing of this Act, nor during that period except with the licence of the local authority, and in the event of such licence being granted, then only for such period not exceeding three years from the passing of this Act and under and subject to such terms and conditions as shall be therein prescribed." No advertiser will go to the expense of an elaborate sky sign, such as an electric one, if he cannot have any greater security than three years' return for his money. Again, the licence of the local authority becomes void if any addition or alteration be made to or in the house, building, or structure on, over, or to which any sky sign is placed or attached, if such addition or alteration involves the disturbance of the sky sign or any part thereof, or if the house, building, or structure over, on, or to which the sky sign is placed or attached become unoccupied or be demolished or destroyed. There ought also to be some security against the unreasonable suppression of signs exceeding the three-foot vertical projection, where it can be proved to the local authority that there is no danger to passers-by from mechanical or electrical breakdown.

The actual hardships which will be placed on commercial men by such absurd legislation as it now stands are sufficiently obvious. Advertising is nowadays an essential part of business organisation, and no means which are honourable and fair should be placed outside legal limits. It should be a serious consideration where æsthetics are, to a certain extent, opposed to utilitarian interests, that, after all, the welfare of the country depends upon its increase of trade, both internally and externally, and restrictive legislation of this sort is simply stifling business expansion.

Even if this thing were logical, it would be sufficiently bad, but it is not even reasonable. Presumably the most pertinent objection to a sky sign is that, unless it is strongly fastened and sufficiently protected, it may, in a high wind, fall over and injure passers-by. But why in the name of common sense such exception should be taken to a sky sign, when properly secured, the voltage at the lamp terminals of which cannot exceed 240, while at the same time bare copper wires are strung from support to support in the middle of main thoroughfares, charged with 550 volts, and subject to the constant strain of passing cars, without any objection, but rather with the concrete support of the Corporation, is a mystery which cannot be solved by any ordinary individual. The whole trend of this legislation seems fatuous. It is on a par with the by-law recently passed for the metropolis, compelling the screening of flame arc lamps placed outside show windows as an advertisement. It is a thing which would not for a moment have been tolerated in any American city, and is a glorious example of the course of procedure which has given our foreign competitors the opportunity of triumphing over British progressiveness.

Influence of Wave-form on Efficiency.

It has long been known that differences between the wave shapes of a synchronous motor and the alternator supplying it may adversely affect the efficiency of the system, but numerical results have seldom been published, and some particulars given by Herr Carl Holmboe in a recent number of the *Elektrotechnische Zeitschrift* will, therefore, be of interest. A certain direct-current central station had occasion to transmit 200 KW. to a distance of 8 km., and for this purpose a direct-current motor driving a 5,000-volt three-phase alternator was installed. In the distant sub-station an exactly similar synchronous motor-generator set was installed to reconvert to direct current. After the sets had been running for some time, careful efficiency tests were made; the ratio $\frac{\text{direct-current power}}{\text{three-phase power}}$ for the central station set, and the ratio $\frac{\text{three-phase power}}{\text{direct-current power}}$ for the sub-station set at full load (200 KW.), was found to be 84 per cent. By suitably adjusting the exciting current, the power factor of the transmission could be made unity.

About a year and a half later the central station was converted into a three-phase station, and the motor-generator in the central station was no longer required, as the sub-station motor-generator could now be run direct from the main three-phase generators. After this had been done, the efficiency tests were repeated, and it was found that the efficiency had fallen to 79 per cent. at full load. At the same time the power factor could no longer be made equal to unity, but fluctuated between the values of ·91 and ·98. This result was confirmed with checked instruments, and, in order to make quite sure of the figures, the original method of running (using the central station motor-generator) was once more tried; this again showed the higher efficiency of 84 per cent. and the better power factor. It was, therefore, clear that the difference in behaviour was entirely due to the use of the large steam-driven alternator, with its different design and its uneven turning moment, in place of the motor-generator set. An investigation showed that the steam-driven alternator had three slots per pole and phase, whilst the alternator of the motor-generator set (and the synchronous motor) had two slots per pole per phase. The open circuit phase voltage curves for the steam alternator and for the synchronous motor respectively were determined, and the subtraction of the ordinates of one curve from those of the other resulted in a curve of treble frequency. When the machines are loaded the curve shapes will be altered, but the treble frequency (150 cycles) difference will still exist, and will serve to maintain a current of this frequency round the armature windings. Owing to the high self-induction of these windings this current will be small, but the eddy-current loss (which depends on the square of the frequency) and the hysteresis loss (which depends on the 1·6th power of the frequency) due to this current may very well be appreciable, and this loss, together with the increased copper loss due to the lower power factor, will account for the lower efficiency observed. The motor-generator ran for about 4,000 hours a year, at an average load of 60 per cent. of full load, and the cost of 1 KW.-hour in this particular station was ·72d., so that the annual loss, owing to the reduced efficiency was—

$$200 \times \cdot 6 \left(\frac{1}{\cdot 79} - \frac{1}{\cdot 84} \right) 4{,}000 \times \frac{\cdot 72}{240} = £109,$$

or equal to the interest on a sum of about £2,000.

Boiler Performances.

To the practical engineer, and even to many of those who live by slide rule and formula, the term "boiler efficiencies" suggests, in the first instance, the claims that So and So's Induced Draught, or Somebody Else's Stokers, or Another Person's Properly Patented Speciality will effect a certain percentage reduction in the coal bill, and that a judicious selection may give record coal consumptions and beautiful thermal efficiencies. Questions as to thermal efficiencies are threshed out in this country in the technical Press, and there are two conceptions as to the methods of computing such efficiencies. We shall recite the two views later in this article. At present we wish to draw attention to an investigation that is being conducted in the United States.

The authority undertaking the research is the Technologic Branch of the United States Geological Survey. At first sight one wonders at the connection between the Geological Survey and boiler efficiencies. It seems that not only in the Gilbertian comic opera do permanent officials do curious things. The English theory of a Government department is that it is a body authorised to formulate regulations and to ensure their due observance. The English practice has its manifest fruits in the safety of our railways, and in the absence of electrolytic troubles due to currents from tramway systems. We are not quite sure what the American theory exactly is. Upon the practical side, the practice seems to depend greatly upon the need for refraining from

upsetting the "bosses," with the result that the Interstate Commerce Commission does not govern the railways in the sense that the Board of Trade does. Thwarted, therefore, in the pursuit of what would be regarded in England as reasonable departmental activity, trans-Atlantic departments give themselves to work which would be carried out in England at technical colleges or by engineers in private practice. The United States Geological Survey accordingly has one of its departments investigating boiler efficiencies.*

This department declares that "Experiments now being conducted . . . at St. Louis, Mass., have suggested that stationary boilers ought to be made to do 10 to 20 times as much work per unit of heating surface as they do now." Before we can assent to this proposition, we should like to know what is regarded by the investigator as current practice? Mr. Bryan Donkin described many years ago how the thermal efficiency of boilers varied at different rates of evaporation, and we need hardly quote his figures. The investigators promise this great increase in capacity partly "by subdividing the heating surface and water streams more finely." Has not this been the aim of every maker of water-tube boilers? It is to be effected partly by "using high forced and induced draught to put a large mass of gases through the boiler at a very high speed." After enunciating these truly momentous principles, the investigators proceed to announce that they have discovered Prof. Perry, that "he is a distinguished mechanical and electrical engineer in England," and that he has written a book touching upon the subject. Some day, perhaps, another department of, say, the Archæological Survey, or the Weather Bureau, may discover Macquorn Rankine, or Regnault. But we must refrain from prophecy, and briefly summarise the projects and views of the investigators. We are really startled at the announcement that it has been found "when keeping the initial temperature of the gases constant" (the air being heated electrically), "that the final temperature of the air remains the same, whatever the amount of air sent through the boiler per second." Can this really be true? If so, is it not an equally justifiable corollary in regard to a surface condenser, that when keeping the initial temperature of the exhaust steam from an engine constant, the final temperature of the water going to the hot well remains the same, whatever the amount of steam entering the condenser per second?

Personally, we should not care to justify this corollary, let alone suggest that surface condensers should do 10 to 20 times as much work per unit of heat-traversing surface as they do now. But is the first hypothesis sound?

Blechynden showed that the transfer of heat per square foot of area is proportional to the square of the difference between the temperatures of the two sides of the plate. Sir A. Durston has shown the effect of differences of cleanliness upon heat transmission. Dr. Kirk also, some 15 years ago, showed the importance of using thin tube-plates. We could quote numerous authorities upon these and similar points, but we have enough evidence to urge that the reports of the Technologic Department will be worthless without noting the thicknesses of plates.

On one point, information of practical interest may be obtained, namely, the effect of the velocity of the gases parallel to the heating surface. Prof. Perry has considered that a high velocity tends to remove an adherent film of denser and cooler gases chilled by the plate itself.

Lastly, as to what should be the standard of boiler efficiency. Mr. W. H. Booth has advocated in these pages what we may call a hot gas standard, in which, if we understand Mr. Booth aright, the efficiency is calculated upon the quantity of heat absorbed from the gases over and above the temperature of the water in the boiler. More common, and perhaps more convincing, is to strike a balance between the thermal value of the coal burned and the thermal units added in the boiler to the entering feed. As a refinement to this test, we would place to the debit side the heat value of the power used in operating a mechanical stoker or in forcing the draught.

* For precedents for this activity we may cite the Canadian Commission on electro-thermic processes for smelting iron and steel, and the work since carried on in Canada by Dr. Haanel. At Washington the Water Purification Division of the Department of Agriculture is investigating the properties of electrolytic hypochlorites as sterilising media.

A TESTING SWITCHBOARD.

The requirements of a switchboard for testing purposes are far different to those of a lighting or power station board; the connections of a station board are permanent, but a testing board should be arranged for easy changing of the connections.

The following description relates to the general arrangement of a board designed for testing D.C. motors and dynamos with a minimum of trouble.

Assuming that the machines to be tested vary from 10 to 500 H.P., with voltages from 50 to 700 volts, the large machines will probably not have a lower voltage than 200 volts, so the maximum current may be taken as about 2,000 amperes.

The board is divided into the main switchboard, auxiliary switchboard and connection board.

On the main switchboard are mounted a number of switch sets; each set comprises either a D.P. quick-break switch or S.P. knife switch and S.P. automatic circuit-breaker, D.P. fuses, ammeter, three terminal blocks, cradle and connections

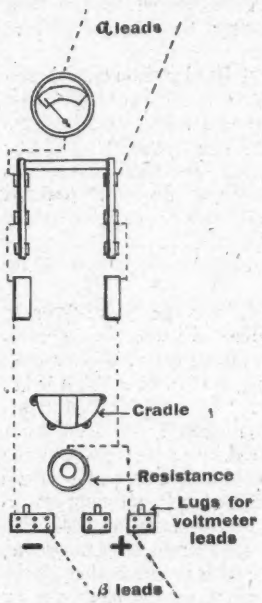

Fig. 1.

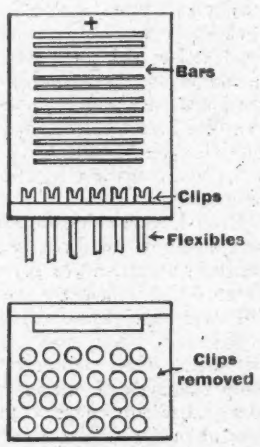

Fig. 2.

for voltmeter, and a starting resistance (fig. 1). Eight sets is a convenient number in this case; their current capacities vary from 50 to 2,000 amperes, the ammeter ranges being as follows:—

Set A	...	0—50 amps.	Set D_1	...	0—500 amps.
Set B	...	0—100 "	Set D_2	...	0—500 "
Set C_1	...	0—200 "	Set E	...	0—1,000 "
Set C_2	...	0—200 "	Set F	...	500—2,000 "

Sets A and B have D.P. switches, the others a S.P. switch and circuit-breaker.

The starting resistances for switch sets E and F would be rather large, and as it is not likely that it would be required to run two large machines as motors at the same time, it will be sufficient if E and F share a starting resistance.

About ten voltmeters is a suitable number, say, two each of the following ranges:—

0—120 volts.	150—550 volts.
50—250 "	300—600 "
500—750 volts.	

Each voltmeter is the same size, so that any one can be placed in any cradle of the switch sets; instead of the usual terminals, flexible leads ending in insulated handles and spring clips are fitted, the spring clips fitting on special lugs on the terminal blocks (fig. 1).

There are three terminal blocks to each set, one negative and two positive, the starting resistance being considered on the positive side.

Variable load resistances will be required, say, three of the following capacities:—

2,000	amperes	at 200 volts	to 600	amperes	at 700 volts.
1,000	"	"	300	"	"
500	"	"	150	"	"

Assume four testing machines, one of 500-H.P., one 300-H.P. one 100-H.P., and one 50-H.P. Each of these will have separately excited fields, controlled by the auxiliary board.

Also assume that there are three sets of mains to the test house, 100 volts (used for lighting the shops), 220 volts (used for driving the shops), and the testing mains connected to the special testing dynamos to give any pressure between 220 and 700 volts.

The connection board is divided into a positive and negative side; the two sides are similar and each consists of a number of horizontal bus-bars arranged one above the other with insulating bars in between on a vertical board, and a number of clips, with insulated handles, to fit on these bars; these clips rest on a horizontal board in front of the bars, and are connected to flexible leads passing through the board (fig. 2).

Consider one side of the connection board: connected to the bars there will be four leads from the testing machines, three mains, three leads from the load resistances, and two or three blanks; connected to the clips, 16 leads from the switch sets (one from each end of each set), and four from the fields of the testing machines.

A number of short flexibles with clips on each end will be required when it is necessary to connect bus-bars together.

As indicated above, there are four leads going from each switch set to the connection board—call the two from the top or switch end the α leads, and the two from the bottom or terminal end the β leads (fig. 1). Suppose it is required to test a generator, practically all the wiring to be done is to run a couple of leads from the generator to the terminal blocks of a suitable size switch set; the α leads of the set will then be put on the bars of one of the load resistances, and the generator circuit is ready, except for the shunt resistance which will be wired up in the usual way. The generator is to be driven by one of the testing machines; to connect this up, put the α leads of a switch set on the bus-bars of one pair of mains, and the field leads on the same pair of bars; the β leads will go on the bars of the testing machine. A voltmeter of suitable range should be placed in the cradle of the generator switch set with its two flexible leads on the terminal blocks.

Consider the case of running two shunt-wound machines in a "series Hopkinson" test: connect the two armatures to the terminal blocks of two switch sets; on the connection board put the two negative α leads on the same spare bus-bar, the positive α lead of the motor switch set put on the positive bar of one pair of mains, and the other positive α lead put on the negative bar. The motor field wire will be connected as usual, but the generator field wire must go to the same terminal as the motor field wire, the ammeters being considered on the negative side of the switch sets and the negative terminal of the machines, the common point of armature and shunt. The ammeters should either read with the current in either direction, or should be fitted with small change-over switches. The two voltmeters required in this case will be put in the two cradles with their leads on the terminal blocks.

These two cases will probably suffice to show the principle of the testing-board and the method of using it.

The above is only intended to give a general description of the board, definite sizes of testing machines, &c., being assumed only to help give clearness to the description.—J. L. C.

Self-Propelled Fire Engine.—The fire brigade authorities at Berlin have for some time past been making experiments with an electrically-propelled fire engine and a steam-driven fire engine. As a result of the trials, it is stated that both systems are suitable for the requirements of the German capital, and that the electromobile in particular, on account of its readiness, comes into consideration in the first rank as a substitute for the engines drawn by horses. Steam-propelled engines of larger powers than those already tested would be of great value as reserves for the second "trains" of engines, and in the circumstances it is thought possible that a change over to a mixed system may take place in the future.

THE DRAFT REGULATIONS OF THE HOME OFFICE.

We have received a copy of the draft regulations which the Secretary of State for the Home Department proposes to make, in pursuance of Sec. 79 of the Factory and Workshop Act, 1901, for the generation, transformation, distribution and use of electrical energy in premises under that Act, together with a covering letter, from which the following is extracted:—

In October, 1904, the Secretary of State issued in draft certain Regulations based on existing requirements of the Board of Trade, having reference to the use of electrical energy at medium pressure. It was found, however, that, although the requirements had been for some years in force as Board of Trade Regulations, many difficulties arose in regard to their enforcement as Regulations under the Factory Act. As the proposed Regulations covered only part of the ground which (as explained in the circular of October, 1904, accompanying the draft) had eventually to be covered, the Secretary of State decided to defer the consideration of them until a more complete code could be prepared.

The present draft applies to the generation and transformation, as well as the distribution and use, of electrical energy on all premises under the Factory Act, and at all pressures above 130 volts continuous and 65 volts alternating. In adopting the above limitations on the basis of pressure, the Secretary of State, while realising that there may be danger at still lower pressure, has been guided by the fact that the serious accidents from shock which have come to his notice have been at pressures exceeding those named. Special consideration has been given to the conditions under which preventible accidents have arisen. The Secretary of State regrets to learn that while, in many electrical installations, the utmost care has been taken to prevent unnecessary danger, there are striking exceptions to this rule, even in work recently carried out. It appears often to be thought that where the supply of electrical energy is at low pressure, there is no danger of shock, or rather, that there is no danger to life from a shock at such pressure. It has, however, been abundantly proved that this is not the case. The dividing line between the conditions which will render the shock merely trifling and those which will render it fatal is so narrow that it becomes necessary to provide, so far as is practicable, that no shock shall be received at all.

In accordance with the requirements of the Factory Act, the Regulations are now published in draft, and are subject to further consideration. Any objections of substance, made by employers, workpeople or other persons affected, will be carefully considered by the Secretary of State, and will, if necessary, be the subject of full inquiry made by a competent person appointed by him.

Such objections must be sent to the Secretary of State within 40 days from this date (August 14th, 1907).

The regulations differ wholly from the draft regulations which were issued in October, 1904; those closely followed the Board of Trade Regulations, and were commented on at some length in our columns. The new draft regulations are reproduced below. It will be borne in mind that they apply to electricity works as well as to non-electrical workshops and factories, except where otherwise specified. The definitions are omitted.

Draft Regulations.

These regulations shall come into force on January 1st, 1908, except as regards such parts of electrical stations as were constructed before July 1st, 1907, in respect of which they shall come into force on July 1st, 1908.

If the occupier can show with regard to any requirement of these regulations that the special conditions in his premises are such as to prevent danger not less adequately than if the said requirement were observed, that requirement shall be deemed to be satisfied.

Regulations.

1. All apparatus and conductors shall be sufficient in size and power for the work they may be called upon to do, and so constructed, installed, protected, worked, and maintained as to prevent danger.

2. All cables shall be covered with insulating material, and further efficiently protected where necessary to prevent danger; or they shall be so placed and safeguarded as to prevent danger.

3. Every switch, circuit-breaker, and isolating link shall be:—

(*a*) So constructed, placed, or protected as to prevent danger.

(*b*) So constructed and adjusted as accurately to make and to maintain good contact;

(*c*) Provided with an efficient handle or other means of working, insulated from the system;

(*d*) So constructed or arranged that it cannot accidentally fall or move into contact when left out of contact.

4. Every switch and circuit-breaker shall be so constructed as to be incapable of remaining in partial contact, or of maintaining an arc on breaking circuit.

5. Every fuse, and automatic circuit-breaker used instead thereof, shall be so constructed and arranged as effectively to interrupt the

current before it so exceeds the working rate as to involve danger. It shall be of such construction or be so guarded or placed as to prevent danger from overheating, or from arcing or the scattering of hot metal or other substance when it comes into operation. Every fuse shall be of such construction or be so protected by a switch that the fusible metal may be readily renewed without danger.

6. Every electrical joint and connection shall be of proper construction as regards conductivity, insulation, mechanical strength, and protection.

7.* Efficient means, suitably located, shall be provided for cutting off all pressure from every circuit.

8.* Every circuit shall be efficiently protected from excess of current, and every circuit arranged to carry more than 750 watts shall be separately so protected.

9.* Where one point of a system is connected to earth, no single pole switch other than a link for testing purposes shall be placed in any cable connected thereto.

10.* Where one of the main conductors of a system is uninsulated and bare, such as a bare return of a concentric system, no switch, fuse, or circuit-breaker shall be placed in that conductor, or in any conductor connected thereto, and the said conductor shall be earthed.

11. Every motor, converter, and transformer shall be protected by a switch or switches, suitably placed, and so connected that all pressure may thereby be cut off therefrom and from any apparatus in connection therewith.

12.† Every electrical motor shall be controlled by an efficient switch or switches for starting and stopping, so placed as to be easily worked by the person in charge of the motor.

Every electrical motor rated at more than one-third of a horse-power shall be further protected by a release that will automatically break the circuit if the current is interrupted, unless the motor is incapable of re-starting automatically on the current being restored.

In every place in which machinery is being driven by any electrical motor, there shall be means at hand for quickly stopping the motor.

13. Every flexible cable for portable apparatus shall be connected to the system either by efficient permanent joints or connections or by a properly constructed connector.

Every portable apparatus and its flexible cable shall be independently controlled by a switch conveniently placed.

Adequate precautions shall be taken against shock, due to leakage or other cause, in all places where the person handling the portable apparatus is not insulated from earth. In such places, and in any place where the pressure exceeds low pressure, the switch shall be so constructed as to break the circuit on each pole.

14. The general arrangement of switchboards shall, so far as reasonably practicable, be such that:—

(*a*) All parts which may have to be adjusted or handled are readily accessible;

(*b*) The course of every cable may be readily traced;

(*c*) Conductors connected to different systems are kept apart and can be readily distinguished;

(*d*) All bare conductors are so placed or protected as to prevent danger from accidental short-circuit.

15. Every switchboard having conductors normally so exposed that they may be touched shall be located in an area or areas set apart for the purposes thereof and suitably fenced or enclosed.

No person except an authorised person, or a person acting under his immediate supervision, shall have access to any part of such area.

16. All apparatus appertaining to a switchboard and requiring handling shall so far as practicable be so placed or arranged as to be operated from the working platform of the switchboard, and all measuring instruments and indicators connected therewith shall so far as practicable be so placed as to be observed from the working platform. If such apparatus be worked or observed from any other place, adequate precautions shall be taken to prevent danger.

17. At the working platform of every switchboard and in every switchboard passage-way, if there be bare conductors exposed, or arranged to be exposed when live so that they may be touched, there shall be a clear and unobstructed passage of ample width and height with a firm and even floor. For low pressure and medium pressure the clear height shall not be less than 7 ft. and the clear width not less than 3 ft., and for high pressure and extra-high pressure 8 ft. and 4 ft. respectively.

Bare conductors shall not be exposed on both sides of a switchboard passage-way unless either the clear width of the passage is double that otherwise required, or the conductors on one side are so guarded that they cannot be accidentally touched.

Adequate means of access, free from danger, shall be provided for every switchboard passage-way.

18. In every switchboard for high pressure or extra-high pressure.

(*a*) Every conductor within reach from the working platform, or in any switchboard passage-way, shall be so placed or protected as to prevent danger.

(*b*) The metal cases of all instruments shall be either earthed or completely enclosed with insulating covers.

(*c*) All metal switch handles and all metal rods connecting them with the switches shall be earthed.

(*d*) Every switchboard in continuous use shall be so arranged that the conductors thereof can be made dead in sections, and no work shall be done at any section unless that section be made (*a*) dead, and (*b*) so separated by permanent or removable divisions or screens, from all adjoining sections of which the conductors are live, that the work may be carried out without danger.

19. All fixed coils, conductors or terminals of generators, motors, transformers or other apparatus, at high pressure or extra-high pressure, and within reach from any position in which any person employed may require to be, shall be so protected as to prevent danger.

20. Where a high pressure or extra-high pressure supply is transformed for use at a lower pressure, adequate means shall be provided to prevent the lower pressure system from being accidentally charged above its normal pressure by leakage or contact from the higher pressure system.

21. Adequate precautions shall be taken to prevent any metal other than the conductors from becoming electrically charged, and such metal shall be earthed where necessary to prevent danger.

22. Adequate means shall be provided and used for preventing any conductor or apparatus from being accidentally or inadvertently electrically charged when persons are working thereon.

23. Where necessary to prevent danger, insulating stands or screens shall be provided and kept permanently in position and shall be maintained in sound condition.

24. Portable insulating stands and screens, boots, and gloves, shall be provided and used when necessary to prevent danger, and shall be periodically examined by an authorised person.

25. Adequate working space and means of access, free from danger, shall be provided for all apparatus that has to be worked or attended to by any person.

26. All those parts of premises in which apparatus is placed shall be adequately lighted to prevent danger.

27. All conductors and apparatus exposed to the weather, wet, corrosion, or to inflammable surroundings or explosive atmosphere, or used in any process or for any special purpose other than for lighting or power, shall be so constructed or protected, and such special precautions shall be taken, as may be necessary to prevent danger in view of that exposure or use.

28. Adequate periodical tests shall be made by an authorised person to ensure (*a*) that the insulation of all conductors and apparatus is duly maintained; (*b*) that no metal part of any apparatus, other than the conductors thereof, is electrically charged so that there is danger; and (*c*) that all earth connections are in order. Adequate periodical examinations shall also be made by an authorised person to detect any other defects from which danger may arise.

29. No person except an authorised person, or a person acting under his immediate supervision, shall undertake any work where technical knowledge or experience is required in order to avoid danger.

30. Instructions as to the treatment of persons suffering from electric shock shall be affixed in all premises where electrical energy is used, other than for incandescent lighting at low pressure, and in all premises in which electrical energy is generated or transformed.*

31. Every sub-station shall be of ample dimensions and substantially constructed of fire-resisting material; and shall be so arranged that no person can obtain access thereto otherwise than by the proper entrance, or can interfere with the apparatus or conductors therein from outside; and shall be provided with efficient means of ventilation and be kept dry.

32. Every sub-station shall be under the control of an authorised person, and none but an authorised person or a person acting under his immediate supervision shall enter any part thereof where there may be danger.

33. Every underground sub-station shall be provided with adequate means of access by a door or a trapdoor, with a staircase or ladder securely fixed and so placed that no switchboard or bare conductor shall be within reach of a person thereon:

Provided, however, that the means of access shall be by a doorway and staircase if (*a*) any person is regularly employed therein, other than for inspection and cleaning; or if (*b*) there is moving machinery therein, other than ventilating fans; or if (*c*) there is extra-high pressure therein.

Portable Combination Meter.—The unique combination of a voltmeter, ammeter, wattmeter, and horse-power meter in one instrument is accomplished in the "Victor" for direct current, manufactured by the H. W. Johns-Manville Co. The success of this instrument for switchboard purposes has led to its introduction in a portable form for general electrical testing. The "Victor" meter consists of two separate and complete instruments in a single case, the one giving readings in volts and the other in amperes. The pointers of the two instruments cross one another, and at the position of intersection the ampere-volt product or power consumption can be read off on a third dial. The power scale is calibrated in "watts" or "kilo-watts" on one side and "horse-power" on the other. If desired, multiple shunts and extra multipliers are furnished in connection with the volt and ampere scales for additional readings, and a table, containing the multiplying factor to be used with these various combinations when reading the central scale. The convenience of having such a combination instrument in a portable form will be readily appreciated, as the meter is adapted for rapid testing in the laboratory as well as in the field.—*Electrochemical and Metallurgical Industry.* Vol. V. No. 7.

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* This does not apply to public supply circuits.

† This does not apply to the motors of motor-generators, regulators, &c.

* Illustrated sheets of instructions for treating subjects of electric shock can be obtained from H. Alabaster, Gatehouse & Co., 4, Ludgate Hill, London, E.C.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Simplex Conduit Bending Machine.

The machine shown in the accompanying illustration is a new design for making almost any set or bend in the smaller sizes of conduit or other tubing. The whole of the working parts are mounted on a cast-iron base. These parts include a main roller round which the tube is bent and two smaller rollers, one of which is the advance or "breaking down roller" and the other the bending roller. In addition to this there is an adjustable vice mounted on the base, which holds the tube firmly in position during the operation. Each of these rollers is adjustable and easily removed, which allows the tube to be easily taken out when bent.

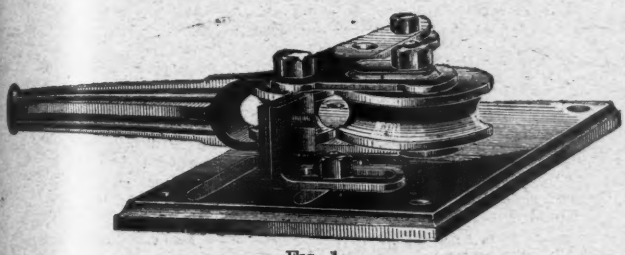


FIG. 1.

The rapidity with which bends can be made is an important factor. In this pattern the method is simple; the tube is pushed between the bending and the large roller (which are provided with grooves to fit the tube) and clamped in the vice. The lever arm, which is provided with a recess to take a "tommy," is pushed or pulled round, causing the two smaller rollers to travel round the large one, and giving the tube a set corresponding with its periphery. Other types of bends are merely a matter of adjustment of the tube; in the case of small bends it is advisable to use the smaller rollers only. All parts are adjustable, and as during the process each roller revolves on its own axis, there is no jamming action on the tube, so that it is not flattened and the enamel is not damaged.

Portable Electric Winch.

The accompanying illustration, fig. 2, shows the latest standard pattern of electric winch made by the SUNDERLAND FORGE AND ENGINEERING CO., LTD., of Sunderland, embodying all their most recent improvements.

The winch is of substantial construction, suitable for the rough handling of shipyards, &c. The first reduction is through worm gearing, consisting of a worm cut from the solid and gearing with a phosphor-bronze wheel, running in oil, the end thrust being taken up by collars in a thrust-block lined with white metal; the second reduction is effected by machine-moulded spur gearing. The motor is of the company's "Pallion" enclosed multipolar type, with fixed carbon brushes, and the controller, which is of the tramway type, is fitted into a watertight box forming part of the motor case, the resistance being inside the latter; the whole of the machine is therefore self-contained, and being waterproof, can be worked in exposed positions without fear of damage from the weather. A foot-brake working directly on the motor shaft is provided in a convenient position. Such winches are made capable of handling from 30 cwt. to 5 tons, at a speed of about 30 ft. per minute in most cases.

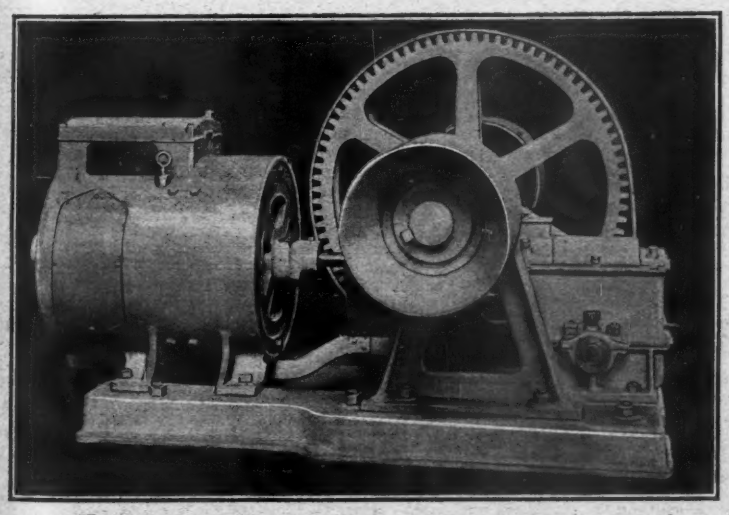


FIG. 2.

THE BRITISH ASSOCIATION MEETING AT LEICESTER.

On the Pupin Mode of Working Trunk Telephone Lines.

By SIR WILLIAM PREECE, K.C.B., F.R.S.

(Section G.—Abstract.)

IN 1896 I read a paper before Section A at Liverpool on "Electric Disturbances in Submarine Cables," in which I dealt with the subject of long-distance speaking by telephone. I pointed out that disturbances were due to energy being in the wrong place. An alternating-current wave, set up in a telephone transmitter by a complete sonorous vibration impressed on the diaphragm, flowing for the period *a g*, fig. 1, if its voltage were indicated by *a b* when *positive* and by *d e* when *negative*, would possess in one received wave an energy proportional to the area bounded by *a b c e f g*, if it were wholly utilised, but would only describe the area *a a' d d' g* if the unshaded portion of the figure were proportional to the energy radiated or leaked away, absorbed as a charge or dissipated as heat. The attenuated current thus indicated shows what radiation, leakage, capacity, hysteresis and resistance may do to absorb energy and deteriorate the clearness and loudness of speech as well as limit the distance to which ordinary speaking is practical. I had previously, in 1887, pointed out that the product of the capacity K and the resistance R gave a law which approximately indicated the distance to which speech was possible on telephone circuits. It accurately indicates the distance on single wire submarine cables. In 1890 I read a paper giving the calculations on which the London-Paris telephone line, with its cross-channel cable, was designed and constructed in association with the French engineers. In 1892 it was determined to establish trunk telephone wires between the great commercial centres of Great Britain. All the calculations were based on the K R law. It is quite certain that this law is not absolutely true, for it neglects the factor of self-induction. The K R law is properly of the order K R/L, but experience has shown that inductance on short metallic loops is so small compared with capacity that it may be neglected. Mutual inductance between the two wires compensates to some extent the self-induction in each wire. In long underground cables and long aerial wires, however, the influence of inductance becomes evident as the length of lines increases. On the other hand, capacity also increases owing to the variation of the mutual (wire to wire) capacity and the capacity of each wire to earth, which becomes an important factor with concentric cables or with any departure from symmetry. This is why "Hughes's twist" is so valuable and so superior to the "Cross" system so general in America. It not only completely prevents "cross-talk," but it secures a constant capacity with earth.

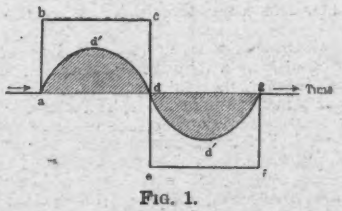


FIG. 1.

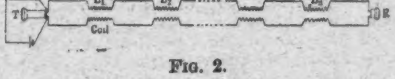


FIG. 2.

It is known that the effect of this electromagnetic induction is beneficial in one sense, as I pointed out in 1896, and it has been made more beneficial in another sense by Prof. Pupin (1899), who has shown how we can reduce the weight of copper used on trunk lines and also how we can extend the distance to which ordinary speech is practical.

Pupin's system is not so much the neutralisation of the effects of

electrostatic capacity by those of electromagnetic inductance as a system of hastening the discharge of pent-up energy without additional loss by breaking it up into many successive steps. In a long submarine cable discharge is a slow process and all in one operation. The KR is great and the frequency small. In a "loaded" line it is much more rapid, for it is performed simultaneously in several successive stages, of much shorter length and with much less waste or distortion.

The factors of energy E and Q are pent up by capacity and inductance. Energy is wasted by resistance, leakage, induction, radiation, reflection and interference. This waste of energy means diminution of amplitude, attenuation of wave volume, and loss of speech, while electromagnetic induction improperly placed means distortion of wave form, external disturbances and loss of articulation.

The establishment of the telephone trunk system in Great Britain in 1896 showed the practical value of the KR law in determining the construction of an aerial system. The weight of copper used in the main trunk lines has been criticised, but the only fault committed was that I did not specify enough. Paris can speak with Liverpool, Manchester and Hull, but it cannot do so commercially with Glasgow and Edinburgh. London can speak with Aberdeen, Inverness and Dublin, but not with Cork. Pupin coils have not been applied permanently to the Post Office trunk lines, but careful experiments have been made to feel the way to do so, and thus perhaps extend the range of Paris talks in Great Britain.

By the enterprise of the American Bell Telephone Co. and its allies great progress has been made in the States in developing the system. I purpose to report the results of a careful inspection I made in New York in April last, of the very successful work done in this direction by the New York Telephone Co., under the able direction of their chief engineer, Mr. John Carty.

The factors that enter into the problem of trunk wire working are very numerous and complicated. They are *physical*, *commercial* and *personal*. It is not a question of mathematics, but of experiment.

What are the factors in long-distance speaking, in addition to the ordinary elements of electrical energy—viz., electromotive force, resistance, capacity, inductance, current and time?

1. Eddy-current heat losses in diaphragms.
2. Hysteresis in coils, cores and circuits.
3. Change of wave-shape due to storage and waste of energy in other forms.
4. Attenuation of waves due to dissipation of energy and its absorption.
5. Loss of the higher notes called "harmonics."
6. Reflection of waves from breaks and alterations in circuits.
7. Reduction of efficiency due to leakage, polarisation, radiation and induction to neighbouring bodies.
8. The reactions and interferences of neighbouring circuits.
9. The constant change of every condition of circuit elements by switching through to different towns and subscribers.
10. The variable formation of the human mouth, tongue and teeth of different users.
11. Defects of articulation and want of experience in handling the apparatus by the users.
12. The inefficiency of hearing and interpretation of the listener and the absence of silence about him.
13. The absence of telephonic education in both speaker and listener.

The remedies are self-education, selection of proper apparatus, symmetry of circuits, the proper distribution of the controlling factors, the restoration of stored-up energy, the alliance and mutual forbearance of users and suppliers.

It is clear from this incomplete enumeration of the factors involved that the problem of the reproduction of clear speech at a variable distance is a very complicated one. It has been solved by very patient plodding, by incessant experiment, and by judicious compromise.

The K R law as applied to submarine cables is very useful for calculating the speed of working, but inasmuch as trunk telephone circuits are aerial and telephonic currents alternating and very variable in form, self and mutual induction must play an important part in their propagation. It was found, however, by experiment that metallic circuits of copper wire suspended in air and constant in character were benefited by self-induction. Hence, in designing the trunk system of the Post Office in 1891, inductance was neglected.

Hertzian waves are disturbances of the ether of very high frequency, of the order of millions per second, having the velocity of light—viz., 186,000 miles per second. Telephonic oscillations in insulated copper conductors are of the order of hundreds per second, having a variable velocity of the order of 1,000 miles per second. The length of a telephonic wave may be from 1 to 100 miles, but that of a Hertzian one may be from 1 ft. to 10,000 ft.

Prof. Pupin, in 1900, established the existence of these waves in telephonic circuits and measured their lengths, their form and their damping. He has reached a practical stage and has been the means of creating a very great advance in the economic development of long-distance telephony.

The Pupin coil stores up a portion of the energy which, like a spring under pressure, is ready to react on the release of the forced condition, and is restored. The frequency, within the region of ordinary speech, which may be said to have from 200 to 2,000 sonorous vibrations per second, is not changed, but as distance increases the fine harmonics which give the individual quality or timbre of voice disappear and only the low fundamental tones remain. Thus the length of a circuit allowing a practical talk is limited by the amount of capacity and resistance present. It is increased by the presence of induction when this induction is put in the right place and is of the right character and amount. It is aided by the human ear, which has a magical gift for interpreting into speech what appear to be the merest phantoms of sonorous vibrations.

Fig. 2 illustrates a complete telephone circuit with its Pupin coils. It is one of a pair of twin copper lines of No. 14 B. and S.G., weighing 65 lb. per mile, twisted about each other and insulated with dry paper, having a resistance of 13·7 ohms and a capacity of 0·065 microfarads per mile. Each coil has a pure soft-iron ring core 3 in. in

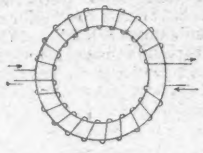


Fig. 3.

diameter, made of fine varnished wires to reduce hysteresis to the lowest possible point, and is wound with two wires, which are connected as shown in fig. 3. Mutual induction is thus eliminated and self-induction alone is active.

It has an inductance of 0·252 henry. Such an underground cable with 112 pairs of wires (loaded) has been laid between New York and Philadelphia, 90 miles long. Nineteen of these pairs are of No. 16 B. and S.G. for a short distance. The Pupin coils have been fixed at every 1¾ miles, and it works with a commercial efficiency which Mr. Carty calls a "14-mile talk." The standard of comparison is a mean circuit of 10 miles of No. 19 (1 mm.) copper wire in the City of New York, which is called the "10-mile talk standard."

Each individual section can be shown diagrammatically, as in figs. 4 and 5.

The straight lines indicate the two wires of the loop, the wavy line the inserted coil. The capacity of the loop is shown as a condenser and the E.M.F. of the coil as a battery cell. In the diagram

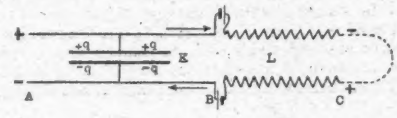


Fig. 4.

they are shown separate, but in activity they act together as in decay to maintain the flow of energy and retain the form of wave. A B C represents *time*. It does not represent length of space or distance. A B and B C must be in tune.

In fig. 5 (1) is the rise of the wave when energy is absorbed and held up.

(2) is the decay of the wave when energy is restored.

Thus in each section energy is held up as the wave is rising and given out again slightly impaired by hysteresis when the wave is falling. It is evident, from the clearness of speech, that the sum of all these actions results in a continuous flow of alternations without change of frequency when the limiting distance is not exceeded. When this limit is reached the waves are so attenuated that speech becomes impossible.

On the other hand, it must be pointed out that although capacity is greater than inductance in its influence on the current waves, they neither absorb energy permanently.

Resistance, radiation and leakage do absorb energy and dissipate it wastefully. Our first object is to prevent waste of energy, and

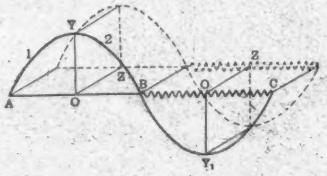


Fig. 5.

our second object to direct the pent-up energy into a proper channel to maintain the amplitude and form of the waves. This is what Pupin has done.

If we represent the action in a Pupin section in another way by fig. 5, where A B represents the metallic loop and B C the double coil, A C being equal to one period of one short fundamental wave, then O Y will represent the maximum E.M.F. acting during the period A B, and O Y_1 that acting in the coil during the same period. O Z represents the quantity of electricity Q flowing during the same period; Q is assumed constant. A solid figure described by Q and E (the variable E.M.F.) would represent the energy propagated, except the minute losses in the section, which are inherent to the conditions of the circuit. These losses multiplied eventually absorb all the energy and the limit of speech is reached. The influence of

the coils is clearly a time influence. They break up a circuit into a series of sections in which the energy flows in virtually simultaneous steps instead of being prolonged and damped down as it would be in a long submarine cable. It is clear that in each wave-length there are four distinctly marked points where changes of phase affect the distribution of energy and its factors. It is as though Q remained for an instant in A B and E in B C. They then change partners with an action that continues the forward movement, but with a slight loss due to waste.

The size of coils and the distance apart is purely a question of experiment. It varies with every circuit. Sir John Gavey has obtained the best results at every 2 miles, Mr. Carty at every 1¼ miles on long lines, but at every ½ mile on short lines. The former gets better results with no iron core, the latter prefers fine iron wire as a core. Mr. Gill, of the National Telephone Co., places them at every mile and uses iron cores; these coils are enclosed in iron cylinders filled with resin oil and buried.

It certainly appears to me that iron must experience some hysteresis, though very minute, and, therefore, causes loss of energy, and though it must enhance the strength of the currents by intensifying the lines of magnetic force, it is of more consequence to reduce the loss of energy and retard the attenuation of the waves.

If the coils are improperly placed or imperfectly designed they do more harm than good. Thus coils which are quite effective at every mile destroy speech altogether if placed at every four miles.

Among the numerous disturbing influences are those of the instruments at each end. Not only does the receiving apparatus act as a reflector and inductor, but it is a source of secondary radiation and causes interference and attenuation. This is very much aggravated by the constant changes of local lines at each end. Pupin has diminished this disturbance by *tapering*, or the gradual reduction of the inductance of the loading coils as the terminal stations are approached.

Tapering is distinctly beneficial. Virtually, as all oscillographs show, it becomes a series of small waves of one frequency, probably of about 800—upper G in the treble—which remains constant. There must be a slight loss of energy in each section of precisely similar percentage. The result is that the curve of attenuation must be a logarithmic one, and its logarithmic decrement or attenuation constant is obtainable. The smaller this decrement is made the greater the length of the curve and the further speech can be carried. This is the function of the Pupin coil.

The inductance coils are usually of three classes:—Heavy, having 0·252 henry; medium, 0·176 henry; light, 0·133 henry. Loading is not so efficient at present on aerial loops because it has not been so thoroughly thrashed out as on underground cables, but it is distinctly beneficial, and the solution of the more complicated problem is well in hand. At present the dimensions of the Pupin coils for aerial loops, as well as the spacing, have to be determined experimentally for each circuit.

The United States Conference standard cable is:—

Weight of copper (lb.)	20
Diameter (mils)	36
Resistance per mile (ohms)	44
Capacity wire to wire (mfd.)	0·06
Capacity wire to earth (mfd.)	0·088
Insulation (megohms)	500
Effective limit (miles)	41·6

in terms of 10-mile talk.

N.B.—Effective limit does not mean effective commercial conversation. This would approach 60 miles.

Our English standard cable is now nearly the same—viz., No. 20 copper wire of 20 lb. weight per mile, having a diameter of 36 mils, a resistance of 44 ohms per mile, a capacity of 0·056 mfd., an inductance of 0·001 henry, and an insulation of 200 megohms. It would be a great advantage if this cable were made an international telephone standard. Mr. Gill has done so with this object in view.

The use of loaded lines is increasing rapidly. The equivalent range of speech has been increased in one case from 66 to 176 miles on an underground cable. Although in Germany they have found the ratio to be 1 : 4, in America it is thought that 1 : 3 is the outside commercial limit, and in Great Britain we find the range of a certain loaded line is 2·4 times that of an unloaded one.

I have been able to test (July 25th, 1907) the relative efficiency of an unloaded and a loaded cable of what should be called the international standard pattern. I found that 8·3 miles on the former was equivalent to 20 miles on the other. This was 2·4 to 1. It was not a test of possible distance, but of relative efficiency.

The result is not equally beneficial in aerial wires, for the conditions are more variable, especially in insulation and in atmospheric electrical troubles in countries like South Africa. Anyway, loaded lines will enable us to use less copper for long trunk wires—something of considerable advantage in these days of inflated prices in copper, and in countries like South Africa, where one long stretch of 1,010 miles has to bring, say, Johannesburg to Cape Town.

The application of this principle to submarine cables has not yet reached a practical stage. Prof. Pupin has the matter in hand on the other side of the Atlantic. The reaction coils must, however, be placed at such small distances apart that the manufacture of such a cable seems difficult and its maintenance problematic.

It has been assumed that the velocity of propagation of the current waves through the circuit is such that the action in each Pupin section is virtually simultaneous, and the action continues along the line. If we admitted geometrical length the physical explanation would be more complicated. A slower velocity in loaded cables means increase in the limiting distance of speech. Hence the reason why the limit is reached so rapidly in cables and underground wires. On overground lines the distance to which it is possible to speak is limited only by the weight of copper; 2,000 miles is easily attained without coils.

The question of loaded underground cables against open unloaded aerial circuits is purely a financial question; the dominant factor is the price of copper. But the cost of maintenance, the reliability of working, and the freedom from troubles must weigh considerably in the balance. Every case must be decided on its own merits.

Discussion.

Sir Oliver Lodge said that the gain of inserting self-induction in cables was very remarkable, and would not originally have been expected. He was glad to have the opportunity of emphasising that that matter was predicted mathematically by Oliver Heaviside many years ago. His first paper on the subject seemed so paradoxical that it was rejected by the Society of Telegraph Engineers (as it then was). He persisted, however, in showing that self-induction was not an adversary, which natural instinct would suggest it was. It helped by perpetuating the features of the wave, strengthening the features that would otherwise have been wiped out by the spring-like action of capacity. They had found that in actual cable work the introduction of self-induction had a most beneficial effect; although it introduced reflection when the wave surface encountered the obstacle, the benefit was great, even though they put the inductance all in one lump—if they distributed it, so much the better. If they inserted 70 or 80 henries into the middle of the cable, it improved the transmission. Sir Wm. Preece suggested that there was a difference between the Hertzian and cable waves, but the less difference there was the better. They must keep the electric and magnetic energy the same. Leakage clarified, although it weakened the waves. It weakened them far too much, so it was somewhat undesirable. A better plan was to strengthen the magnetic energy. Oliver Heaviside proposed, and Pupin had applied his proposal. It was a remarkable case of scientific prevision, and of practical accomplishment.

Mr. S. G. Brown also referred to Heaviside's work in 1890 on the introduction of self-induction into cables, and said that Pupin later on in America made it into a practical success on an artificial cable. They paid him (Pupin) £100,000, and gave him £10,000 a year, but he only claimed to have made a practical solution for Heaviside. After pointing out two main objections, the speaker, referring to work of his own in this connection on submarine cables, said that one of the best ways of dealing with the question was to make the copper and iron of D section and twist them together, but there were difficulties then. Heaviside had said the more self-induction they could put in the better, but there was a limit. There would not be the slightest difficulty in speaking from London to New York if the practical engineers would give the required permeability. They required 1,000 against the 150 that they now got. If they could have the permeability raised to 1,000 they could speak any distance they liked.

Prof. S. P. Thompson said that Sir Wm. Preece had referred to the work that he (the speaker) did in 1891. It was as a consequence of reading the work of Oliver Heaviside that he devoted attention to the matter. It was known that long submarine cables—and indeed short ones—produced retardations which up to that time, and practically still, had only been compensated by means of coils placed at the ends. The retarding influence was distributed all along the cable, and if they tried to compensate it only by compensating arrangements at the two ends, they would not get perfect compensation; not even putting in blocks of self-induction in the middle would compensate for the defects that lay distributed all along. He suggested that the remedy must be distributed, as the defect was. He was met by the fact that the cable companies were then—and were still, to a large extent—absolutely opposed to anything being put near or in conjunction with submarine cables that could by any possibility be called an induction coil. Latimer Clarke told him what the reason was. The first cable of 1857 was destroyed in an attempt to make it speak by means of an enormous induction coil. That destruction having been accomplished by a coil 6 ft. long, no induction coil must ever go near any submarine cable. Not being able to get over the company's prejudice, he thought of another point. Willoughby Smith had shown that by taking a wire from the end of the cable to earth, which would produce a leak across the cable, and causing that wire to possess self-induction by coiling it round an iron core, he obtained essentially an inductive shunt across the end. He obtained compensation at the ends of the cable only, which proved to be beneficial in certain troubles. Seeing that there was this prejudice on the part of the cable companies, and that bridging by means of self-induction had been shown to be quite the simplest way to apply those ideas, the best plan would be not to adopt directly Heaviside's suggestion to put blocks into the cable, but to apply inductive shunts as leaks. That was the main point of what he (Dr. Thompson) proposed in 1891. He proposed a number of variations, and made calculations as to the amount of attenuation produced. He proposed to introduce a self-induction coil at every 100 miles. Pupin's investigations came some few years after his (the speaker's) paper. He had every admiration for Pupin, who followed up Heaviside's plan more closely than he (Prof. Thompson) did. Mr. Brown had alluded to the difficulty of having to lay a cable which was not of uniform thickness. In 1893 Siemens told him that would be absolutely fatal to his plan, but it had been found to be no insuperable obstacle at all, and Siemens's had laid such a cable. He was interested in Mr. Brown's sugges-

tion about winding copper and iron, because that was one of the ways he proposed. He had induction wires made 40 ft. long, so long ago as 1902, and found they could be made long and thin and put inside an actual cable without increasing the thickness unduly. Submarine cable signalling was in a very imperfect stage when they could only transmit at one-tenth the speed at which they could work on rapid lines. If by making cables three times as expensive as at present they could gain a three-fold speed, it would be commercially well worth while, because it did not cost as much to lay a single trebly costly cable as to lay three separate cables. The cost of laying was a very large item in the cost of the cable.

Sir Wm. Preece, in reply, said that he wished to disabuse Sir Oliver Lodge's mind of the idea that the telegraph engineer owed any knowledge to Heaviside as to the beneficial effects of self-induction. Self-induction in his own experience since 1867 had been applied to assist the rapid dispatch of messages on the Wheatstone automatic system. The piece of apparatus that they called the shunted condenser was exactly the same kind of thing that this Pupin's section was. From 1867 to that day there was not a single fast speed working instrument in the Post Office service which was not assisted by applying self-induction to assist the working of the instrument. In his description he wanted particularly to show that it was really a question of tuning. Sir Oliver Lodge thought that inductance in the centre of the cable would be beneficial. A telegraph company experimented on this subject; four coils were taken from one-mile lengths, and lumped together at four-mile lengths. The result was stoppage of speech entirely. In reply to Prof. Thompson, he did not think that Latimer Clarke's explanation was true. The electrician to the Atlantic Telegraph Co. came to that office without any experience whatever, and one of the first things he did was to apply a coil which gave a spark 6 in. to 8 in. long to the submarine cable, and destroyed it. If it were possible to apply Mr. Brown's suggestion—induction at intervals all along the line, which would not affect the mechanical structure or the dimensions of the cable itself—then his objection would be entirely removed. His objection to those coils in the cable had always been that they would be an enormous addition to the great difficulties that the submarine telegraph engineer was already confronted with.

Sir Oliver Lodge asked to be allowed to remove a misconception. Sir W. Preece knew best what telegraph engineers learned or did not learn from Heaviside. Heaviside gave the theory which was now being applied. When he (the speaker) said that insertion of inductance in the middle of an ordinary cable was beneficial, he was not saying what he thought, but what he knew. He was speaking of telegraphy, but it was telephony that Sir W. Preece was speaking about. He (Lodge) was speaking of ordinary cables for ordinary slow speed signalling.

The Arc and the Spark in Radio-Telegraphy.

By W. Duddell, F.R.S.

(Evening Discourse, Friday, August 2nd.—Abstract.)

The wave-lengths which are of practical use in wireless telegraphy at the present time range between 100 and 3,000 metres; the corresponding frequencies in practical use are between 3,000,000 and 100,000 complete periods per second. We require, therefore, to produce in the vertical conductor alternating or oscillating currents of any frequency within this range, and to have a sufficient number of oscillations following one another without interruption to allow of good syntony being obtained.

There are three methods of producing these currents—namely, the alternator, the spark, and the arc methods.

There are great difficulties in the way of constructing an alternator to give such high frequency currents, and I can best illustrate this by taking an example. Suppose that it is required to build an alternator to work at the lowest frequency, namely, 100,000 periods per second, and let us assume that we can drive this alternator by means of a turbine at the high speed of 30,000 revolutions per minute. This alternator could not have a diameter much above 6 in. for fear of bursting; and, as it makes 500 revolutions per second, it would have to generate 200 complete periods for each revolution, so that the space available for the windings and poles for one complete period will be less than $\frac{1}{10}$ in., a space into which it is quite impossible to crush the necessary iron and copper to obtain any considerable amount of power. In spite of the small space that we have allotted to each period, as there are 100,000 periods per second, the speed of the surface of the moving part works out at over 500 miles per hour. A small alternator has been built to give over 100,000 frequency, but the amount of power it produced was extremely small. Several experimenters have stated lately that they have built alternators giving these high frequencies and a considerable amount of power, but, so far as I am aware, there are no reliable data available as to the design of these machines.

If it should prove possible to construct alternators for these very high frequencies, we shall be able to obtain a sufficient number of consecutive oscillations of the current in the aerial of definite frequency to enable very sharp syntony to be obtained. Not only will this greatly reduce interference troubles in wireless telegraphy, but such alternators will be of the greatest value for wireless telephony.

The earliest method of producing high-frequency oscillation was proposed by Lord Kelvin, who pointed out that if a Leydon jar or condenser be allowed to discharge through a circuit possessing self-induction or electrical inertia, then under certain conditions the discharge of the jar is oscillatory.

In practice the aerial conductor acts as a Leyden jar or condenser. It is charged with electricity and allowed to discharge, the current oscillating backwards and forwards in the aerial during the discharge. In many installations Leyden jars or condensers are electrically connected to the aerial, so that the oscillations taking place in them are transmitted to the aerial.

For wireless telegraphy it is usual to charge the condenser or aerial by means of an induction coil or an alternator to a very high voltage, and it is allowed to discharge by means of a spark between the two electrodes which form the ends, so to speak, of a gap in the electrical circuit. As long as the pressure is low the spark gap is a perfect insulator; when the pressure becomes high enough the air between the electrodes breaks down and a spark passes the gap, which becomes conducting, and allows the condenser to discharge. The property of the spark-gap of passing almost instantaneously from a condition of being an insulator for electricity to being an extremely good conductor for electricity is of the utmost value in the spark method of wireless telegraphy. The more perfectly the spark-gap insulates before the discharge takes place, and the more perfectly it conducts after the discharge has taken place, the better it is for our purpose.

If a large quantity of electricity is discharged through the spark-gap, and if the spark lasts a very short time compared with the interval between successive sparks, then a highly conducting spark can be obtained, as well as a good insulation between the sparking terminals when no discharge is passing. When the condenser, or antenna, discharges through the spark-gap, oscillations are set up which radiate Hertzian waves.

In practice in wireless telegraphy it is difficult to obtain a large number of oscillations during each discharge as corresponding with each oscillation; the antenna radiates energy. A large number of oscillations means, if we keep the amplitude of each the same, that we are radiating a large quantity of energy. Besides this radiated energy, which is useful for transmitting messages, there is also energy wasted in heat in the spark-gap, in the conductors, in the glass or other insulation of the condensers. It is this useless part which we require to make as small as possible.

I have lately had an opportunity to determine how many oscillations actually take place in a certain wireless transmission. The experiment was made by photographing the spark as seen in a mirror rotated at a very high speed, and it was found that each spark consisted of nine or ten complete oscillations.

If all the oscillations were of equal strength or amplitude, then there would be very little to be gained by increasing the number of oscillations. As the oscillations die away in the spark method, two or three times this number would probably be required for the best effect. As a matter of experiment very good tuning was obtained with the wireless transmission referred to above.

As an example of the sharpness of tuning obtainable by the spark method, the following test carried out on the Lodge-Muirhead installation at Hythe may be of interest.

The station at Hythe had to receive messages from Elmers End at a distance of 58 miles over land, in spite of the fact that the Admiralty station at Dover, only 9½ miles distance, was transmitting as powerfully as it could, in order to produce interference, and that the regular communications were going on in the Channel between the shipping. It was found possible with a difference of wave-length of 6 per cent. to cut out the interference from the Dover station.

In the arc method of producing continuous oscillations we employ, as before, a condenser and self-induction; but, instead of charging the condenser to a high voltage and allowing it to discharge by means of oscillations which die away, and then repeating the process over and over again, we actually maintain the condenser charging and discharging continuously without any intermission, so that we practically obtain a high-frequency alternating current in the aerial.

The arc method of producing continuous oscillations is founded on my musical arc.

With the carbon arc between electrodes in air the voltage decreases very rapidly when the current is gradually increased, starting from very low values. As the current becomes larger the rate of decrease of the voltage becomes less and less until it is, comparatively speaking, quite small, with a current of 10 or 12 amperes. With the arc between metal electrodes similar results are obtained, except that the discontinuity in the curves, called the hissing point by Mrs. Ayrton, takes place at very small currents, generally well below an ampere.

With arcs burning in hydrogen, Mr. Upson has found that the curves are generally much steeper for the larger values of the current than for the corresponding arcs burning in air. This point is of great importance as explaining the value of the hydrogenic atmosphere used by Poulsen and referred to later.

In general, I may therefore say for the above arcs that increase in current through the arc is accompanied by decrease of the potential difference between its electrodes, and *vice versâ* decrease of the current causes increase in the potential difference; on the other hand, certain arcs, such as the arc between cored carbons, behave in an opposite manner, that is to say, current and potential difference increase and decrease together.

I demonstrated in 1900 that if I connect between the electrodes of a direct current arc (or other conductor of electricity for which an increase in current is accompanied by a decrease in potential difference between the terminals) a condenser and a self-induction connected in series, I obtain in this shunt circuit an alternating current. I called this phenomenon the musical arc. The frequency of the alternating current obtained in this shunt circuit depends on the value of the self-induction and the capacity of the condenser,

and may practically be calculated by Kelvin's well-known formula. Besides the condition that an increase of current must be accompanied by a decrease in potential difference, it is necessary that the relative decrease in potential difference produced by a given increase in current, that is to say, the steepness of the characteristic, shall exceed a certain minimum value which depends on the losses in the shunt circuit. It is also necessary that an increase in current shall be accompanied by a decrease in potential difference, even when the current is varied very rapidly.

For wireless telegraphy by means of Hertzian waves, based on my arc method, we require much higher frequencies in the shunt circuit. If we attempt to obtain this higher frequency from the ordinary arc burning between solid carbons in air, we find that above a certain limit the oscillations will no longer take place. This is due to the fact that we are varying the current through the arc at this higher frequency too quickly for an increase in current to be accompanied by a decrease in potential difference. I have demonstrated that if I only vary the current through the ordinary arc sufficiently rapidly, then an increase in current is accompanied by a proportionate increase in the potential difference, and the arc behaves just like an ordinary resistance. If we work with very small current arcs, we can obtain high-frequency musical arcs burning in air either between carbon or metal electrodes.

In a paper read before the International Electrical Congress at St. Louis in 1904, Mr. Poulsen showed that by placing the arc in a flame it was possible to obtain higher frequencies than when the arc was burning in air. Following this up Mr. Poulsen came to the conclusion that the best results were obtained when the arc was burning in hydrogen, or a gas containing hydrogen; and he further added a magnetic field around the arc somewhat similar to that which has been previously used by Elihu Thomson.

The arc burning in coal gas in a powerful transverse magnetic field was used by Poulsen in his early experiments to produce the high-frequency current necessary for wireless telegraphy between Lyngby and Esbjerg in Denmark. This apparatus has been further improved, and is now employed by the Amalgamated Radio-Telegraph Co.

In both the arc and the spark methods of wireless telegraphy we employ a high-frequency alternating current in the aerial conductor. The essential difference between the two methods lies in the fact that with the spark method our alternating current in the aerial conductor first increases to a maximum value and then dies away rapidly, making only a limited number of oscillations, whereas in the arc method the oscillations are maintained continuously of unvarying amplitude.

With the arc method we are further able to choose the number of consecutive oscillations which make up each signal, sufficiently great to obtain the very best syntony. On the other hand, improvement in the arrangement and construction of the apparatus for the spark method has so increased the number of oscillations corresponding with each spark that it may be that we shall be able to obtain a sufficient number in each train to give as good syntony by this method as with the arc method.

The arc method seems eminently suitable for very high speeds of working. As the oscillations are quite continuous, we can cut them up into groups to form the dots and dashes of the Morse alphabet, just as if we were working with a continuous current, such as is used on land lines, so that there seems no reason why as high a speed of working should not be obtained from the arc method of wireless telegraphy as is obtainable by automatic signalling on land lines; for it is to be noted that the dot or shortest signal of the Morse alphabet, even at a speed of three or four hundred words per minute, will last long enough to consist of many hundreds of oscillations of the current in the aerial, so that there will be plenty of oscillations in the group forming the dot to give good syntony.

Turning to the spark method for high working speeds, we find a difficulty in that the dot of the Morse alphabet must at least occupy the average time required to charge the condenser or aerial and produce one spark, and preferably sufficiently long for several. We are, therefore, obliged in the spark method to use a high rate of sparking for high-speed signalling. This difficulty has not become very serious with the present low speeds of sending. When we come to use considerable amounts of power to transmit messages over long distances, and we also require a high speed of working, the practical difficulty in constructing apparatus suitable for sufficiently rapid sparking will become serious.

Mr. Marconi in 1905 claimed to have already reached a speed of 100 words per minute by the spark method, and lately there has appeared in the technical Press examples of high-speed signalling by the British Post Office over a distance of 15 miles, in which readable signals were received at a speed of 70 words per minute.

Turning to the receiving end, almost all the receivers that have been used in the spark method can be equally well used for the arc method; for it must be remembered that the transmission in either case is effected by Hertzian waves traversing space, and that the only fundamental difference consists in the number of oscillations in each train of waves. It must be noted, however, that in those methods in which a telephone receiver is used, it is necessary to break up the continuous oscillations of the arc method into groups succeeding one another sufficiently rapidly to produce an audible sound in the receiver; for in the spark method the sounds we hear in the receiver correspond with the succession of impulses of the diaphragm, one for each spark at the transmitter. This chopping up of the continuous wave-train so as to produce audible signals in the receiving apparatus can be done either at the transmitting end or in the receiving apparatus. An example of this latter method is Poulsen's ticker.

The question whether receiving apparatus can be arranged so as to receive messages from stations equipped with the spark apparatus and from stations equipped with the arc apparatus is a matter of enormous importance at the present moment in view of the probable ratification of the Berlin Convention, which imposes an obligation on all commercial stations to intercommunicate without regard to the make or system of transmitting apparatus employed. I am of the opinion that there will be no difficulty in carrying this into effect provided that the stations using the spark method send out long trains of waves, as they should do to obtain syntonic working, which is also called for by the Berlin Convention.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession*

Proposed Electrical Exhibition in Manchester.

In your editorial of the 23rd inst., you refer to the intention of the National Electrical Manufacturers' Association to hold an Electrical Exhibition in Manchester next year, and advise your readers to support that Exhibition rather than the Franco-British project, and whilst I heartily support that view, I am of the opinion that the executive of the National Electrical Manufacturers' Association have committed a gross mistake in deciding upon Manchester. I profess to have some knowledge of the opinion of a large number of members of the Manufacturers' Association on the matter, having been present at the meeting at which the proposition was originally discussed, and I venture to say that the attitude of a large majority of the members of the Association is hostile to Manchester as a suitable centre for a National Electrical Exhibition.

I find in perusing the official catalogue of the 1905 Olympia Exhibition, that no less than 70 per cent. of the exhibiting firms were London firms, and the question will arise as to whether this large number of London firms, or what percentage of them, can be induced to support Manchester; and if it is doubtful that the Exhibition will meet with general support on the part of the London element, the Exhibition cannot be fairly expected to be successful.

I hold the view, and I believe it is the view of a large majority of the members of the Manufacturers' Association, that London is the only place for an Exhibition of the kind, and that a show in any provincial town, no matter how important a provincial town—and I do not wish in any way to detract from the importance of Manchester—can at the best be a local performance, and if it cannot be raised above that local standard, I contend that it cannot be successful.

A large number of London firms, and possibly many provincial firms, will refuse to support Manchester, and I regret, and extremely regret, that the Executive of the Manufacturers' Association should have pledged its official support to Manchester. London, in England, is different to Paris, in France, and different to Berlin, in Germany—London is the all-important centre which possesses a drawing power, and in particular for exhibition purposes, which is enormous, and London as the centre of a project of this nature lends a prestige which no provincial centre can confer.

I do not know of any exhibition of a similar nature which has been successful in the provinces, whilst I know of many which have been unsuccessful, and whilst it may be argued that if Glasgow can successfully run an International Engineering Exhibition, Manchester may expect to run successfully a National Electrical Exhibition, it must be borne in mind that the scope of the one is infinitely smaller and much more restricted than that of the other.

I fear the exhibition will have an essentially provincial and local character at Manchester, and whilst in that capacity it may be exceedingly useful to Manchester and Lancashire, it would not necessarily be useful to the electrical trade at large, and to firms supporting the exhibition.

I suggest that it is not too late to reconsider the matter, and the question should be submitted to the members of the Manufacturers' Association, with a view to obtaining expression of opinion, first, as to preference for London or Manchester, and secondly, as to the likely number of firms

who will support Manchester. The matter was debated before, and I think the discussion proved that by far the largest number of the members of the Association object to Manchester, and object to Manchester strongly.

If the matter is not submitted to ballot in the manner suggested, it will remain to be seen what number of the 130 London firms who supported the Olympia Exhibition, 1905, will go to Manchester. My contention is that only a small number of these firms will support Manchester, and if that assumption is correct, the failure of the project is a foregone conclusion.

W. Schmahl.

London, E.C., *August 27th*, 1907.

[Any advocacy that we may have used regarding an electrical exhibition was made purely in the belief that it was wanted and that the electrical industry of this country stands to benefit therefrom. An electrical exhibition in London next year seems to be out of the question, it would clash too directly with the Franco-British show. Manchester and Salford have resolved to hold their exhibition, and presumably those who have gone into the matter are convinced that success will follow, or the scheme would not have gone forward. Does Mr. Schmahl suggest that, in face of this resolution, the 51 members of the National Electrical Manufacturers' Association should hold aloof? That seems to us to be quite contrary to the spirit of the Manufacturers' meeting held on April 9th (see ELEC. REV., April 12th). We did not form the impression at that meeting that there was any general feeling that Manchester was the wrong place, but we did hear decided views expressed to the effect that, if Manchester and Salford Corporations followed up their avowed intention, the Association must reconsider their vote against the year 1908. As we understand the matter, it is not the intention of the Manufacturers' Association to *hold* the exhibition. That body, like other organisations, will merely have its delegates on the executive, as it will also, we believe, have a representative on the Franco-British Committee.

Did the 1905 exhibition at Olympia meet the needs of all parts of the kingdom? We are aware that many prominent officials and councillors came up specially to visit it, but does not the vast industrial and manufacturing district around Manchester and Salford stand to profit from an electrical awakening? May not an imposing and thorough-going show in the district be more likely to "draw" engineers and works managers than Olympia could do then or even now? And who will profit from an electrical awakening if it is not the manufacturer, the supplier and the contractor?

To our mind, the difficulty of the present position—we presume from Mr. Schmahl's letter that there *is* a difficulty—is due to the divided feelings among members of the Manufacturers' Association in handling the matter, its famous resolution to boycott any exhibitions but its own, and the endeavours of some of its members to shelve the matter of exhibitions indefinitely.

It may be that there is a reasonable need for electrical exhibitions both at Manchester and in London, but that is hardly a practicable course for next year. Manufacturers cannot be effectively represented at both places at one and the same time, nor in their present state of mind are they likely to try to be. But if there is a strong feeling in the Manufacturers' Association in favour of an exhibition in London, why does that feeling not take a definite shape? Our correspondent does not know of any exhibition of a *similar nature* in the provinces that has been successful. Does he know of *any similar* electrical show held, say, in the last 10 years, *in the provinces?* We wonder what were the *unsuccessful* electrical exhibitions? We do not think the big electrical show has ever had a trial there, unless Newcastle could be supposed to claim that dignity, and that we certainly do not think was considered a failure. We do not remember Glasgow holding an *International Engineering* Exhibition.

Do our manufacturers appreciate the importance of being represented at exhibitions? Are not such displays, when properly organised, and when attended by the right people, more likely to yield a good return than expenditure upon advertisements in serio-comic, technico-popular publicity magazines with which the public, save in a few cases, have neither time nor disposition to worry their heads?

Let us repeat that we have no Exhibition axe to grind. We want to see the electrical industry in this country make headway. It is for the manufacturers to decide whether they will, or will not, exhibit three years after Olympia; we merely expressed the view that the Manchester display was to be preferred to the Franco-British as an electrical engineering trade opportunity. In that view Mr. Schmahl concurs, but he prefers London to Manchester.—EDS. E.R.]

Permit me to express my cordial agreement with your leading article last week so far as regards the Anglo-French Exhibition at Shepherd's Bush. But I regret that I cannot extend this to the second part of the article referred to.

I cannot resist an uneasy feeling that manufacturers are being to some extent "roped in," and I shall be glad to hear how far an electrical exhibition is really desired by the trade at the present time. We had a successful exhibition at Olympia, I grant, and I also remember that it was actually agreed at that time that another exhibition of such a representative character could not be held with hope of success until the expiry of at least another five years. I am under the impression that some sort of arrangement or implied agreement with the organisers of the Olympia show was arrived at whereby a sort of option was obtained for the hall. Some time ago, ten years was considered to be quite short enough a period to elapse between exhibitions of a similar nature. Allowing for the progress of the age, five years seems reasonable enough, but to hold them as frequently as we are asked to do seems to me little short of absurd. Besides, it is a question whether manufacturers in general would derive benefit from the proposed Manchester and Salford combined show, and it might even be asked if they were not ill-advised, in the present state of trade, even to consider any such substantial outlay as would be necessary, for so problematical a result.

Perhaps other readers will give their opinions as to the advisability of the proposed course, and its prospects of success. It seems to me, and I believe to many others, that we have been confronted with the question of "Where will you exhibit—Manchester or Shepherd's Bush?" and to have answered in favour of one place or the other without asking ourselves the alternative question, "Or will you exhibit at all?"

An Olympia Exhibitor.

"Cutting."

Your readers will agree with us in stating that there is little margin for the above operation in the matter of tantalum lamps. Further, we understood that the supply houses had a uniform price and insisted on same. A customer of ours, calling to inquire price of tantalums, was informed that same was 33s., whereupon he showed us a quotation from a local firm of 30s. per doz., being informed at the same time that they were of best English make, and not the nasty German make. Supply houses, beware!

Bradford Electrical Engineering Co.
H. H. CASSE, *Manager.*

Bradford, *August 26th*, 1907.

Records and Drawings of Electric Mains.

In Mr. Milnes's article of last week's issue (Aug. 16th), he advocates the use of fuses on all feeders and distributors. This may, perhaps, be an excellent arrangement for a comparatively small town, but for a large system where the company is under penalties for failure or stoppage of supply, it has been found far too expensive. Above all, it obtains for the company or corporation, whichever it may be, a bad reputation, which, with the present keen competition of gas, is a very serious commercial disadvantage.

Distributor fuses blow for small or momentary faults which in the ordinary course would burn clear, and the extra rush of current to the fault, combined with the normal load passing through the feeder and other distributor fuses, makes it extremely difficult to prevent these going, and incidentally to save the whole district from an indefinite period of darkness.

Another aspect is that it is no uncommon occurrence for

leaky gas mains to cause an accumulation of air and gas in underground boxes. The spark caused by the blowing of the fuse of course ignites this highly explosive mixture with, as history tells us, more or less serious results.

Regarding the method of record keeping, maps are kept, I suppose, by every supply concern with any claims to efficiency, but I believe recent practice favours the sketches of consumers' connections, including details and peculiarities, all repaired faults and alterations, &c., upon a card system—using one side for sketch and the other for details—in preference to pasting drawings into a set of books, with a bulky consumers' ledger for details.

H. S. Pursey.

Wakefield, *August 20th*, 1907.

Electric Winches.

On page 297 of the Electrical Review last week, you illustrate and describe electric shipyard winches. In the letterpress the following appears:—"It will be noticed that in order to secure complete water-tightness, the controller resistance is enclosed in the same case as the motor. This is a unique feature, which has never before been developed in electric winch design, and is protected."

This latter sentence, we venture to suggest, is entirely incorrect. We have now been manufacturing electric winches for shipyards for over 12 years, and during the last five years, our standard design, of which we have supplied a large number, has had the controller and resistance fitted in the motor case for the sake of water-tightness.

The Sunderland Forge and Engineering Co., Ltd.
J. Lynn Marr, *Director.*

Sunderland, *August 26th*, 1907.

[We publish a view of the Sunderland Forge Co.'s winch in another column to-day.—Eds. E.R.]

Lightning Conductors.

Natural phenomena are governed by law, and there can be no effect without a cause; the one follows the other in inevitable succession. This is a rule from which even lightning cannot be excepted.. As to whether the action of lightning is unexpected or not depends on the correctness of the observer's deductions. With a written or printed report only as guide, one may easily be misled by a wrong description into supposing the existence of vagaries. Mr. Broadbent appears to make the very common mistake of accepting as necessarily correct all that he reads about lightning effects in newspapers. Unfortunately, no description of an incident can be too improbable for publication, and it is not alone as regards lightning that astounding occurrences are published. An evening paper announced that a man had been found drowned in a bucket of water at Walthamstow; the origin was the finding of a corpse in a pool called Buxton Water!

If one eliminates embellishments in the form of fireballs, thunderbolts, &c., the incidents that Mr. Broadbent contributes show no cause for surprise, if we except, perhaps, the candle and tumbler cut in two, and in that case the statements are not sufficiently authenticated to suggest that the laws of Nature have suddenly been repealed. Years ago I investigated all such incidents as I heard of, but I found I was wasting time, for they either never occurred or were natural occurrences misrepresented so as to make them seem extraordinary.

I am afraid Mr. Broadbent has been reading the Report of the Lightning Research Committee. His assertion that the buildings most often damaged by lightning are those fitted with lightning conductors, is quite incorrect. The proportion of buildings so fitted, yet struck and damaged, is only about 2 per cent.

He is equally incorrect in his suggestion that a perfect lightning conductor ought never to be struck. It is true that points tend to prevent a disruptive discharge to a well protected building, but this action is limited in extent and conditions can easily arise in which points are struck as well as knobs. In the experiments to which he alludes, the lightning conductors on the model buildings I used were provided with points so as to be on a par with the occurrences I was reproducing.

The suggestion that a building with a faulty lightning conductor is in a more unsafe condition than with none, has been made before, but the authors have not attempted to justify the statements. The nearest approach to an explanation was by a Frenchman who said that it might lead the lightning to the owner's bedstead; but so might a gas pipe or bell wire if there was no other conductor.

A conductor might be in such a bad state that the upper and lower parts were missing and only, say, 40 ft. of the middle portion remained; but to assert that it was worse than none at all would be to argue that partial damage would necessarily be greater than complete wreckage of the building from top to bottom. I regard almost any conductor as better than none, but it might be so bad as to be almost useless.

The "perfect conductor," Mr. Broadbent supposes, would be a very faultily applied one if damage occurred owing to side-flash to other metals, and "earthing" those metals independently would not be a cure.

The suggestion that a bend round a coping increases self-induction or electromagnetic-inertia is one that appears to owe its origin to a curious misunderstanding. In one part of his "Lightning Conductors" (Whittaker), Sir Oliver Lodge remarks that lightning has no time to go round, it will jump across in preference; in another part he says that self-induction causes side-flash. In certain quarters one statement appears to have been married to the other, and the issue of this morganatic union is the statement that abrupt bends increase self-induction and so cause side-flash. So often has this appeared that many electricians accept it as legitimate, although it is contrary to electrical knowledge.

Alfred Hands.

London, E.C., *August 26th*, 1907.

Electricity Supply Accounts.

In your article dealing with the L.G.B. Departmental Committee's Report relating to electric supply undertaking accounts, you state that as far as your knowledge goes there is only one isolated case where stores accounts are kept on the system recommended. I would like to point out that the stores accounts of the combined undertakings under my charge have been kept in practically the same manner as that recommended by the Committee since the works were opened in 1903. The whole of the accounts, both capital and revenue, are in my charge, and are kept by an accountant on my staff.

As to the accounts, especially those relating to stores, these have to deal with three departments, viz., tramways, electric supply and installation. As one general store serves for these, it is apparent that a very accurate and detailed system of accounting is necessary. In the first place, everything handled, from a drum of cable to a nail or screw, has its article number, and a record book of such numbers is kept in the accountant's office. A card index, under article guide cards, is provided for the storekeeper's use in the stores. All receivals are entered daily into a receivals book by the storekeeper, similar entries being made into a stores issues book for all goods handed out. No goods are handed out except on a requisition signed by an authorised official, such requisition stating the revenue or capital account number to which the goods are to be charged. The workman signs a receipt on the requisition for the goods. For material returned to store a special form is used by the official concerned, the storekeeper signing the original and duplicate in the book and retaining the duplicate. Materials on this form are described as "good" or "scrap" and priced accordingly when crediting the capital or revenue account concerned.

Without an amount of clerical labour out of all proportion to the results to be achieved, it is not possible, in a combined undertaking, like ours, where direct labour is largely employed, to keep a stock ledger account for each of the 1,700 articles handled. My accountant, Mr. T. W. Wilkinson, therefore devised what I may term a "happy mean" in dealing with this matter. All goods which have a substantial intrinsic value, or those which are only called for at infrequent intervals, and which, therefore, might be the

more easily lost or misused without their being readily noticed, have each a separate account in a loose-leaf stock ledger (locked-back type). These stores are described as "special stores." But for the hundreds of small inexpensive articles in constant use, such as nails, screws, bolts, terminals, paints, &c., it has been found, after trial, to be too cumbersome and of little use to keep separate ledger accounts. If the debits be carefully posted and the transfers properly checked, the stores account in the General Ledger (separated into sub-headings, if necessary) provides a reasonable check upon the value of that class of stores at stocktaking times. Purchases here are debited in the General Ledger *not* to a trading account, and so lost sight of, but to a "stores" account, as mentioned.

In addition to the separate treatment of special stores in the Stores Ledger, a record of the receival and prices of *all* stores is kept on the card system, indexed under article numbers. This method is very convenient for pricing issues rapidly, for costing and other purposes.

We are not afraid of the L.G.B. inspector here, as by our system we can give the exact cost of any piece of work which has been done on capital account since we commenced operations. To enable this to be done, no work on capital account or revenue work of a special nature is commenced without a shop order having been first issued, signed by the chief engineer. This shop order shows the capital or revenue account chargeable, and describes the work to be done, as, for instance, a mains extension. All labour and material is charged under this shop order number, properly costed, and the total reconciled periodically with the postings in the general ledger account concerned. In the installation department, every order received, however large or small, has a job order issued, and the work costed in the same way as a shop order.

I have already, I fear, trespassed too far on your valuable space, but, really, the matter is of the very greatest importance. A proper and accurate system of accounting (and that is half the battle in the efficient management of any business) is bound to be more or less complicated. This may to some extent be gathered from the fact that, apart from account books, card systems, &c., we have in use in the electric supply department, 62 different printed forms; in the tramways department, 81; and a further 62 forms which are used by either department. But a proper system of accounting is like a very good watch which, having its complicated inside once assembled, adjusted and started to work, runs on for years without giving its owner the slightest trouble.

In case it may be thought that the system needs a very large staff, I may mention that ours consists of:—Accountant; five clerks; three boys; storekeeper and assistant.

To carry out the recommendations you make, that every stock item should have its ledger account, would involve an additional expense in clerical labour, and we have found that the results do not justify it.

Frank Ayton,
Chief Engineer and Manager.

Ipswich Electricity Works,
August 27th, 1907.

[We congratulate Mr. Ayton on having organised an excellent system of keeping accounts, so far as it goes. We still hold, however, that the complete system which we have advocated is to be preferred even to the partial system adopted at Ipswich. We are assured that in the particular case to which we referred, the additional expense is small, and has been more than justified by the results obtained—EDS. E.R.]

The Training of Young Engineers.

May I offer a few remarks upon that portion of the very interesting address of Prof. Silvanus Thompson to Section G of the British Association, in which he dealt with the training of youngsters who are to become engineers. I venture to think that he very nearly struck the right chord when he said that youngsters should be taught to think in physics, in mechanics, in geometric space, and not in abstract symbols. To my mind what students need to be taught is to *see* what is going on inside of machines, cables, &c., in the same manner as the novelists I referred to in a letter on another subject a few weeks ago in your columns make their readers *see* the objects they describe. And *the* teacher *par excellence*, to my mind, is he who has the gift of making his students *see* those things. I am afraid that this is still some way from Prof. Silvanus Thompson's ideal, but he is apparently moving in the right direction. The imagination forms a very important asset in the stock-in-trade of the modern engineer, and should be cultivated accordingly. An engineer who is to grapple with the problems that he will meet must see, for instance, the condensation taking place in a steam cylinder or condenser, the osmotic action taking place in a dielectric of a cable, and so on.

I venture to suggest also that it is important that students should be trained to look for sources of waste; to note when they see a puff of steam coming away from a steam pipe at a factory, for instance, that the heat contained in the steam is wasted, and when they see black smoke coming from a works chimney that they are in the presence of another source of waste, and that they should be further trained to understand the difficulties in the way of preventing the waste they will see going on all round them when their eyes are educated.

I suggest also that those who are engaged in teaching engineering in the great majority of cases overlook a very important part of the problem, the fact that by far the larger part of the students can only be workmen. In this country, and in almost every other, a workman can rise to any position he pleases, if he has the brains, the perseverance, the opportunity, and the other qualifications. But just as, though every one of Napoleon's conscripts was said to carry a marshal's bâton in his knapsack, only a very, very small percentage ever rose above the status of full private, so only a very small percentage of those engaged in engineering can rise above a workman. The son of a workman will in the great majority of cases become workman himself, though in a few cases he may rise to a superior position. My contention is that in the schemes for education that are being carried out, it is the man who is to work with his head, and not with his hands, that is being catered for, while the great majority of those for whom education *should* be provided will have to work mainly with the hands, and Prof. Silvanus Thompson's address, in the portion I have referred to, strikingly confirms this. After giving the advice mentioned above, to learn to think in physics, &c., he goes on to say that the mathematical master who refuses to show students how to plot the equations for $y = A \sin x$, or $r = b \sin \theta$, should be left severely alone, as a fossil. But if the master who does give this instruction represents the acme of education in engineering, the youth he is training to become a workman is left very badly out in the cold. Of what use to him is a knowledge of the equations mentioned? Cannot our educational pastors and masters come down a little towards the level of practical utility? Mathematics, as the late Sir William Siemens is reported to have said, is like brandy and many other things—it is a very good servant, but a very bad master. The training that mathematics gives to the mind is very good; mathematical formulæ in moderation are very useful, but to the practical workman who has to attend to a machine, to make a joint, &c., mathematics of the order mentioned by the professor are absolutely useless, and the time spent on them is utterly wasted.

I should like also to break a lance in behalf of the much-abused firms who take apprentices and pupils. I venture to think that in this matter also, those who are directing the education of the young engineer have not grasped the problem. There are again two kinds of what the law calls apprentices; those to whom hand training, or its equivalent in modern tools, is the great thing, and those to whom training of the hand is unimportant, training of the head being the thing.

Further, the problem of apprentices presents itself to large firms and to small ones in a totally different light. To large firms the thing to be looked at is the provision of a succession of skilled workmen, to take the places of those who fall out of the running, and the only thing to be considered is how to accomplish this at the least expense. It naturally pays those firms to get the pick of the youngsters who are coming on, by offering inducements, in the shape of comparatively high wages, and by making their works

sought after. But these firms hardly offer, except in a few cases, anything in the shape of a training. They turn out a large number of expert human machines capable of doing certain limited work very well indeed, and a limited number of special youngsters who are placed in a position to rise, not always because of their merit, and not always because their parents possessed a sufficient competence to smooth things.

With the smaller firms the case is quite different. In the great majority of cases they are really educational establishments just as much as colleges are, and youngsters who pass through them, if they will work, and usually every effort is made to set them to work, acquire a thoroughly practical and a sound theoretical knowledge of that branch of engineering. And to these firms the premiums and the labour of the apprentices may form an important item in the balance sheet.

Every one who has conducted a small engineering business knows the financial difficulties that are constantly present. Pioneering work is largely done by these firms; it is very expensive work—to the pioneer—while the work is of the very greatest value to the community at large. May I ask if there is any reason why those who conduct pioneer businesses, and who perform such valuable work in the matter of training young engineers of all grades, should be denied some recompense for their often arduous labours, and some small assistance in the severe financial struggle they often have to wage.

Sydney F. Walker.

Ashton-under-Lyne, *August 23rd*, 1907.

Illuminated Signs.—A correspondent asks for the address of the firm that fits up the illuminated signs for "Bovril."

Charging Board.—We are asked for the maker's name of the Rotax accumulator charging board.

PUBLIC LIGHTING STATISTICS.

We have received from Mr. Francis Teague, city electrical engineer, Bath, a series of tabulated answers obtained from 41 municipal electrical engineers in reply to questions regarding public lighting. These answers contain a great deal of useful information regarding current practice, including systems of control and supervision, number, duties and wages of arc-lamp trimmers and mechanics, holidays, &c. In passing, we may point out, not for the first time, that a vast amount of such valuable material is collected yearly, but too often after use it is relegated to pigeon-holes and lost to the outside world. If it were made a condition of reply that the answers should be made available to electrical engineers in general, or, at any rate, to municipal electrical engineers, in the public-spirited manner adopted by Mr. Teague—better still, if it were stated in the inquiry itself that such a course would be followed—the engineers who furnished particulars of their procedure, often at the cost of much time and trouble, would have the satisfaction of knowing that their labour would be beneficial to the whole industry; and the complaint which is uttered from time to time, that these inquiries are so numerous as to become a nuisance, would lose its force.

The value of a collection of data of this kind increases in proportion to the number of contributors, or even more rapidly, and is greatly augmented by continuation from year to year.

Although we have no direct information to that effect, we presume that engineers who wish to consult the complete return can obtain copies of it from Mr. Teague. We, therefore, here give only the results of a brief analysis of such of the data as lend themselves to that process. Wages, duties, &c., depend so greatly upon local conditions that to summarise them would be an unprofitable task.

We find that the total number of arc lamps installed in the 41 towns for public lighting, including a number in course of erection, is well over 12,000, an average of nearly 300 each. Seven towns have upwards of 500; Edinburgh, with 1,176, and Glasgow, with 837, are easily first in this respect. In 29 towns incandescent and Nernst lamps are used, the total number of points being about 8,760, an average of over 300 each. This, however, represents not the number of lamps, but *groups*; as the number of lamps in a group varies from 1 to 10, the figures are rather indefinite. Probably the average is about two lamps per group.

The majority of the arc lamps are of the open type, of which there are 9,377, installed in 35 towns; the enclosed type comes next, with 2,007 in 22 towns; and flame arcs number 377, in 16 towns, with one installation of 105 (Hackney) in course of erection. It will be seen that many towns use two or more of the three types; in one case the type is not stated.

The most interesting figure here is the number of flame arcs in use. At Hastings the whole of the lamps (105) are of this type, and both here and at Hackney, magazine lamps have been chosen.

In the case of the former, the engineer reports that the magazine holds nine pairs of carbons, and the lamps, which burn all night, are controlled with time switches. They are fitted with lowering gear, and are trimmed by two lads, whose *spare time* is employed on mains work. The lamps have given "complete satisfaction, none having been out during the three months of use." We anticipate that Mr. Ferguson's correspondence will be heavy for some time to come.

In most of the towns ladders or tower wagons are used for trimming the lamps, but in many cases lowering gear is adopted for some of them. We may say, roughly, that 30 towns mainly use ladders, and six mainly use raising and lowering gear, while five use ladders and gear indifferently. Two engineers strongly recommend lowering gear, which they find much cheaper and more efficient, and a third is converting all lamps not already fitted with it.

Many other interesting data are given, less amenable to general treatment; for these we must refer our readers to the printed report.

BUSINESS NOTES.

Regenerative Control Litigation. — Raworth's Traction Patents, Ltd., announce in an advertisement in this issue that they are defending the action started against them, and are prepared to indemnify all users of their equipment against any proceedings that may be taken. They declare that in no single instance have they supplied or fitted up an equipment containing any infringement of the Lundell patents.

New Manufacturing Works in Italy.—The Thomson-Houston Co., of Milan, and the Società Italiana d'Elettricità have just decided upon an increase in the latter's share capital from £240,000 to £360,000, and the new shares are being taken over by a group headed by the Italian Commercial Bank. By means of this augmentation in capital and an association arranged with an Italian syndicate formed of the Southern and Mediterranean Railway Companies and of other important interests, the funds will be provided for the erection of manufacturing workshops in Italy, and for the establishment of closer relations with the Italian financial and industrial world. It is expected that, as a consequence of these arrangements, the business of the Thomson-Houston Co. will receive an important impetus, especially in regard to the development of electric railways in that country.

Catalogues Wanted in New Zealand.—We are asked to announce that Mr. S. Irwin Crookes, A.M.I.E.E. (late of Battersea Polytechnic), is taking up consulting work, and would be pleased to receive manufacturers' lists at the Technical College, Auckland, New Zealand.

Correction.—In our notice of the registration of Messrs. G. A. Steinthal & Boydell, Ltd., on page 311 of our last issue, we stated that the first directors were W. P. Steinthal, H. M. Steinthal, and J. H. Boydell. We learn that the second name is incorrect, and should read H. M. Boydell. Mr. H. M. Steinthal was father of Mr. W. P. Steinthal, and he having died two years ago, has or had, of course, no connection with the newly formed company. Mr. W. P. Steinthal has now issued notice to the trade concerning the change in the business name, &c. He states that the management of the business will continue as before, at Bradford and Manchester, with the assistance of Mr. Henry Moxon Boydell, an electrical engineer, who has been engaged with the Westinghouse Co. for a number of years.

Condensing Plant.—Among the contracts just secured by The Mirrlees-Watson Co., Ltd., is one from the Lancashire Dynamo and Motor Co., Ltd. (for Huelva, Spain), for one low-level counter-current jet condensing plant with duty 10,000 lb. steam per hour; one from Messrs. Fraser & Chalmers, Ltd., for one surface condenser with 6,000 lb. steam per hour; and from the Coatbridge and Airdrie Electric Supply Co., for air and circulating pumps.

Horsfall Destructors.—The U.D.C. of Hampton, Middlesex, has, subject to the consent of the L.G.B., accepted the tender of the Horsfall Destructor Co., Ltd., for a refuse destructor for the district. Other plants which the company have in hand at the present time include the destructor section of an electrical station at Greenock, N.B., on their new "tub-feed" system; also a "tub-feed" plant at Newcastle, and one at Warsaw, Russia. Further orders include a "back-feed" plant at Shettleston, Glasgow, and extensions and alterations to existing Horsfall destructors at Lowestoft, Padiham and Ashton-under-Lyne. We learn that the large Horsfall "tub-feed" destructor at St. Petersburg is now in full and satisfactory operation, also a smaller plant at Tzarskoe Selo.

United States Electrical Exports.—The *Electrical World* for August 10th states that the electrical exports from the United States in 1906-7 were valued at £3,453,680, a gain of nearly 20 per cent on the preceding year. The total was fairly evenly divided between instruments and heavy machinery. The United Kingdom and the British Colonies took a large share, while Mexico and Japan were also good customers.

Catalogues and Lists.—Messrs. J. P. Hall & Co., Blackriding Ironworks, Werneth, Oldham.—32-page (stout glazed paper) price list, giving half-tone illustrations and dimensional diagrams, with tabulated price particulars of their different types of dynamos. The matter is clearly and concisely set out. Separate code words have been included for every listed winding, for the purposes of foreign customers.

Mr. Archibald Campbell, 27, Chancery Lane, W.C.—Circular relating to "Bronskol," a materal for dynamo and motor brushes, trolley wheel contacts, rheostats, &c. (supplied by the Aktiebolaget Bronskol, of Stockholm, for whom Mr. Campbell is British agent).

North American Copper Co., 34, Gracechurch Street, London, E.C.—Two small booklets, one relating to Phono-electric wire and the other dealing with Bridgeport pumps, made by the Bridgeport Brass Co., of New York.

Armorduct Manufacturing Co., Ltd., Farringdon Avenue, E.C.—Twenty-page catalogue, in which are given particulars of a complete range of pure and vulcanised india-rubber insulated wires and cables, aerial, shot-firing and motor-car cables, flexible light cords, bell and telephone wires, insulating materials, &c. Pages 4 and 5 contain a table of general data relating to sizes, &c., of conductors, giving a comparison of wire gauges, &c. The firm has extended its private telegraph code.

The Sheffield Engineers, Ltd., Sheffield.—Several leaflets relating to their manufactures:—(1) Giving prices and a few particulars of their "Hercules" wood-split pulleys with built-up rim; (2) showing the "Simplex" oil economiser pump, and the firm's coke-crusher; (3) containing prices, &c., of the "Sheffield" Plummer blocks with cast-iron swivel bearings.

The A.E.G. English Manufacturing Co., Ltd., London, W.C.—Folding card, giving prices and illustrations of "Luna" Nernst lamps and fittings therefor.

Messrs. Wright & Wood, Ltd., Halifax.—Large postal card, illustrating and tabulating prices of their special slow-speed continuous current protected type motors.

Mr. Albert C. Hands, 30 and 32, Snow Hill, E.C.—Fourth edition of their catalogue of electric light fittings. In the course of some 96 pages a large variety of switch-cover, bell-push and other ornamental metal work is followed by illustrations of electric light brackets, lanterns, hall pendants, electroliers, rise and fall pendant fittings, ceiling fittings, newel pillars, billiard pendants, glass and silk shades, &c. Prices are stated in all cases.

Messrs. O. C. Hawkes, Ltd., Aldersgate Street, E.C., and Birmingham.—Catalogue No. 24 consisting of 32 pages of illustrated descriptive and priced matter relating to their electric illuminating signs. The firm have specialised in this now-becoming-important line, and have aimed at standardising the parts in a manner likely to commend itself to the electrical engineer. It is believed that central station engineers will be specially interested in this interchangeable standardised letter system, and the method of efficient sign-building shown. A complete system of cheap interchangeable individual letters are detailed, and with regard to illuminated wood letters, it is suggested that the engineer can estimate for a complete sign of any size, and calculate current consumption and running cost from the data given. Great attention is shown to have been given to electrical detail. Messrs. Hawkes claim to have produced a sign which will give a good insulation test. The patent "Crystalline" lettering is largely used, producing a scintillating effect when illuminated. The "Gold Light" lettering is also an effective novelty. As our readers are probably aware, Messrs. O. C. Hawkes, Ltd., have been glass and metal manufacturers in Birmingham for nearly 40 years, and are in a position to turn out this class of goods in large quantities. Their electric stoves and special electric light fittings have already been made familiar to our readers.

Messrs. Veritys, Ltd., Manchester.—New list (No. 564) describing and illustrating their new "Vee" type house service switch or motor-switch (patent applied for), their "Fin-Grip" fuses, "Plume" fuses, and the Aston "Safety" fuse boxes. Prices are quoted in the list.

Edison & Swan United Electric Light Co., Ltd., London, E.C.—Leaflet No. I 2,097, relating to their power gauges (sector pattern moving iron type) for electric motors.

Messrs. R. J. Nicholson & Co., Manchester.—Small leaflet relating to their "Junior" Ideal electric lighting outfit for a 45-light house.

Mr. Lancelot W. Wild, York Mansion, York Street, Westminster, S.W.—Four-page circular containing a description with diagrams of the Wild Flicker photometer.

Messrs. Pinching & Walton, 52, Cannon Street, E.C.—Twelve-page pamphlet describing Alph. Huillard's patent drying machine, in which an automatic apparatus secures the drying of precipitated or pasty products.

Messrs. Bagshawe & Co., Ltd., Tower Royal, E.C.—Leaflet describing their vertical bucket elevator for grain, ashes, &c.

Messrs. C. A. Vandervell & Co., Warple Way, Acton Vale, London, W.—Second and revised edition of their 1907 catalogue of C.A.V. ignition accumulators, cycle and car lamp batteries, ignition coils, charging plants and sundry accessories which are of interest to the motorist. We have also received from the firm a perpetual calendar, such as they will be pleased to send to any of our readers who apply for same.

Aluminium for Electrical Purposes.—We have this week received several publications which show the increased attention that is being given to this subject.

The British Aluminium Co., Ltd., of 109, Queen Victoria Street, E.C., and Foyers, who have for some time past been supplying increasing quantities of aluminium bus-bars and cable (both stranded and solid) to well-known firms, have now issued some lists of tabulated data which the trade may find of interest. Sheet H is a lengthy list of a few of the users of aluminium wire for electrical power transmission in America, showing H.P. transmitted, length of line, voltage, size and weight of wire, &c. Sheet J is a table of particulars of conductors, stating diameters, sectional area of aluminium and copper comparatively, number of strands, weights, carrying capacities and resistances. Leaflet L shows some specimens of aluminium conductor joints.

From Messrs. Johnson & Phillips, Ltd., of Charlton, there has been received an advance proof of an 8-page pamphlet dealing with Paterson's aluminium electric cables, the front cover of which announces "A Revolution in the Prices of Electrical Conductors." Here, too, a list of some American users, and what they use, is given, followed by tables of insulated and uninsulated electric light and power cables. The extent of the revolution in prices is left over for the reader to ascertain through the post, the idea of the publication being to stimulate interest in the subject. The firm considers that the time has now arrived when business may be done in aluminium conductors, many of the difficulties which have previously prevented aluminium being used with success, having now disappeared. Formerly the makers of aluminium were unable to produce a practically pure metal, which had the effect of lowering the conductivity. Now, however, it is stated that the average commercial aluminium has a purity of about 99·6 per cent., and that as the production of aluminium has increased the price has decreased. How great has been the increase in production and consumption, and what extensive steps are now on foot for extending the manufacture of aluminium, are things well known to our readers by reason of our various recent references to the matter. Messrs. Johnson & Phillips say that even after taking into consideration the recent fall in the price of copper, the price of aluminium stranded wires of a conductivity equal to copper can be supplied at a price showing a considerable saving when compared with the price of a copper conductor. A further and obvious advantage that the use of aluminium has for overhead transmission lines, is that fewer and lighter poles may be used, and it will be easily understood that when the question of transport is a point to be considered, the saving is frequently considerable, owing to the lightness of the material. Messrs. Johnson & Phillips are now prepared to quote prices for either insulated or bare aluminium conductors, and are prepared to give guarantees as to the purity and conductivity of the metal, and they will send a copy of the booklet mentioned above to anyone interested.

The Electrification of La Belle Sauvage Printing Works.—It is only by the adoption of modern methods, of which perhaps the most important is electrical driving, that old-established printing works can compete successfully with other newer rivals. When boilers and steam plant have done their duty, the question rises as to whether these shall be replaced or whether the machines shall be electrically driven and the old steam plant turned out. In view of the many advantages which accrue from the electrical driving of printing machinery, there can, of course, only be one answer to such a question. We learn that one of the latest works to be completely electrified, so far as the driving of machinery is concerned, is the historic works of Messrs. Cassell and Co., Ltd., of La Belle Sauvage; the electrification has been carried out to the specification, and under the personal supervision, of the company's consulting engineer, Mr. Frank Broadbent, M.I.E.E., of 4, Queen Street Place, London, E.C., and is, we understand, all in accordance with the new requirements recently issued by the Home Office. Automatic solenoid starting gear has been adopted throughout the main machine room, and we hope later to be able to describe some of the special features in connection with the equipment.

Dissolution.—Kuhl & Vogt, mechanical and electrical engineers, 5, Chester Road, The Brook, Liverpool.—Messrs. C. O. M. Kuhl & G. H. Vogt have dissolved partnership.

Book Notices. — *Universal Directory of Railway Officials*, 1907. London: Directory Publishing Co., Ltd. 10s.—This is a new edition of what we have found to be a very useful reference work. It is compiled from official sources under the direction of Mr. S. R. Blundstone, the editor of the *Railway Engineer*. There are both alphabetical and geographical sections, and the arrangement is as satisfactory as could well be desired. In hunting up an electrical reference or two to check the accuracy, we tumbled across the statement that the Metropolitan Railway has "10 *electromotives*, 99 motor carriages and 206 trailers." In these days of contractions this is not a bad way of rendering electric locomotive, but we are afraid it was unintentional, for the words "electric locomotives" are drawn out at their full length in an entry elsewhere.

"*Buckle, London*." By P. T. White. Wigan: Roger & Rennick. 1907. Price 6d.—This is a collection of short stories, describing incidents in the career of an ocean detective, Mr. Buckle, who is an engineer by training, and has a gift for falling in with exactly the right people to serve his turn at the precise moment when he wants them. We have read several of the storiettes without finding evidence that Mr. Buckle possesses any of the qualities usually ascribed to detectives—in fiction—or becoming interested in the rather confused series of incidents described. The disjointed, elliptical style in which the book is written annoys the reader, to say nothing of numerous errors of spelling and composition, such as "inobstrusive," "infer" for imply, "I make no pretention of knowing," &c.

"Glasgow and West of Scotland Technical College Calendar, 1907-8." Glasgow: The Technical College. 1907.

Messrs. Archibald Constable & Co. announce that they will publish during the autumn a new and comprehensive work on Electrical Measuring Instruments, Recorders, Meters, &c., by Mr. Kenelm Edgcumbe, M.I.E.E.

Austria.—The cable works at Leopoldau, Vienna, belonging to Messrs. Siemens & Halske, of Berlin, are being acquired by the Austrian Siemens-Schuckert Works Co.

Rumoured Amalgamation of Electrical Firms.—A south-east Lancashire trade correspondent says rumours are again current that a well-known and powerful Manchester electrical firm is negotiating for the purchase of the businesses and plant of two smaller firms in Cottonopolis. No details are as yet available.

Fire.—A serious fire occurred on the premises of Messrs. Siemens Bros. & Co., in Bowater Road, Woolwich, on Saturday night. It broke out in a large building used as a laboratory, cable tank house and store.

Bankruptcy Proceedings.—E. Bohm.—At a sitting of the London Bankruptcy Court held on Tuesday before Mr. Registrar Hope, the public examination was held of Ernest Böhm, electric lamp manufacturer, who applied to pass upon accounts showing unsecured debts £1,120; fully secured debts £1,600 (the securities held by those creditors being valued at £16,000); a preferential debt of £11 for rent, and assets valued at £19,400, consisting of a good book debt of £5,000, and the estimated surplus of £14,400 from the securities in the hands of the creditors treated as fully secured. The debtor accordingly estimates that, subject to realisation, he will have a surplus of £18,269. According to the observations of the Senior Official Receiver, the debtor, who is a German, states that he came to England in 1880, and from 1883 to November, 1903, carried on business in London, first as lamp-maker and afterwards as glass-blower and manufacturer of chemical apparatus. In 1901 he patented an electric lamp, and in November, 1903, agreed to assign his interest in the invention to a firm of accountants. He was subsequently employed in the manufacture of the lamp until April, 1904, but was then dismissed, and shortly afterwards commenced proceedings for specific performance of the firm's agreement to form a company. In February, 1905, a company called "Bohm's Lens Lamp Co., Ltd.," was registered by the firm, but he never received any shares therein. In August, 1905, in anticipation of an arrangement being come to with the firm, he sold his interest in the invention to a limited syndicate, called "B.N.C., Ltd.," by which he was afterwards employed until June, 1906, the sale consideration being £653, payable as to £150 in cash, and as to the balance in shares in the syndicate, which undertook to form a company (with a nominal capital of £60,000) to acquire the patents. On the formation of this company he was to have received £250 in cash and £17,500 in shares, and in December, 1905, a company styled the "Lens Lamp Co., Ltd.," was registered, but it never went to allotment. In April, 1906, proceedings were commenced against him and the syndicate by the petitioning creditor, with the object of having it declared that he (the petitioning creditor) was absolutely entitled in the events which had happened to the said invention and patents, and (alternatively) of enforcing a charge which had been given to him for the purpose of satisfying the claim of the aforesaid firm of accountants, and in November, 1906, judgment in the plaintiff's favour was given. In May, 1906, he had commenced an action against the petitioning creditor and others who had been concerned in the dealings with the said patents, claiming damages for fraud and alternatively for breach of contract, but he failed to proceed with the action owing, he says, to lack of funds. Since April, 1904, he has also earned money by glass-blowing and dealing in electric lamps at his residence, where his wife has also carried on business as glass-blower since 1892. The debtor further stated that his invention was an electric lamp fitted with a series of lenses which increased the light five times over without adding to the cost, apart from that of the original manufacture. He attributed his failure to inability to realise his interest in the invention; to his liability of costs (returned at £903) in connection with the legal actions, and to his expenditure having exceeded his income. The fully secured creditors held a charge on, and a receivership order over his interest, on the agreement of November, 1903, whilst the "good book debt, £5,000," returned as an available asset, represented the claim for damages against the petitioners and others, as before mentioned. Mr. Hewett, on behalf of the petitioning creditor, also questioned the debtor, and the examination was then ordered to be concluded.

G. F. Frizell.—At the same sitting the public examination was held of George Fredk. Frizell, whose accounts showed total liabilities £463 (unsecured £415) and assets £1 11s. 6d., after deducting £15 18s. 6d. for payment of the preferential claims. In the course of his evidence, the debtor stated that from April, 1901, to September, 1905, he was a partner in an electrical business at 175, Denmark Hill. At the latter date the business was sold, and all the liabilities were discharged. Witness had since been in business in the Walworth Road, and at Battersea he had traded as the Electric Laundry Co. He attributed his insolvency to loss on the sale of two laundries, bad debts, stoppage of the business for six weeks owing to a breakdown of machinery, and to other causes. The examination was concluded.

Trade Announcements.—Messrs. J. P. Hall & Co., of Oldham, announce that their works are to be closed from to-day (August 30th) to September 9th, for annual holidays, but all correspondence will be dealt with in the ordinary way.

Mr. Victor H. Coates, M.I.M.E., has opened an office at 2, Norfolk Street, Strand, W.C., where he will start business on September 1st, as Victor H. Coates & Co., engineers. We understand that the designs, working drawings and data of the old firm of Victor Coates & Co., Belfast (formed in 1791 and now closed), are Mr. Coates's property, and he has made arrangements with several firms to continue the manufacture of certain boilers, engines and machinery. He will also act as selling engineer and agent for machinery.

Mr. G. Braulik, having now extended his test rooms and works, is in a position to undertake repairs of every description in connection with all makes of arc lamps, arc lamp accessories, &c.

Messrs. J. H. Tucker & Co., manufacturers of electrical fittings and apparatus, have changed their address to King's Road, Hay Mills, Birmingham. Their telephone number is now "50, Acocks Green."

Installation Contract.—Messrs. E. Hulse & Co., Ltd., engineers, of Salford, have placed the work of electric lighting for five of their shops with Messrs. J. Lomax, Kendal & Co., Ltd., electrical contractors, of Manchester. The method of lighting is to be with the Gilbert rod feed standard street lighting arc lamps fixed upon brackets down each side of the shops below the travelling cranes.

LIGHTING and POWER NOTES.

Australia.—Sydney.—The municipal undertaking earned a total income during 1906, of £40,984, and after deducting working expenditure there remained £19,416 gross profit. Financial charges absorb £10,931 (interest) and £3,186 (sinking fund) leaving a net profit of £5,299. Of the latter sum £4,770 has been allocated to reserve, and the balance applied in reduction of the loss accrued in the early years of the undertaking. Some 3,977,330 units were sold for private, and 1,227,587 units for power purposes.

Melbourne.—The report on the city electrical undertakings for the year ending February 28th last, shows a gross revenue amounting to £81,189, and working expenses of £35,660, leaving a gross profit of £45,529. After meeting financial and other charges, including £8,303 depreciation, a balance of £17,601 remains for the year. Some £45,000 was expended on capital account during the year, this including expenditure in connection with the change over of the supply system in the outer areas. Owing to the latter work the Corporation has set apart another £12,000 for depreciation, making £20,303 for the year. The progress made by the undertaking has necessitated substantial additions to the power plant, and new turbo-generating plant and switchgear are being added, a 4,400-volt feeder network being installed, and 550 flame arcs ordered—the latter to replace existing lamps. During the year the conversion of the street lighting in the central area was completed, and 135 flame arc lamps installed on steel poles. The completion of this section of the conversion has enabled a large amount of wooden poles and overhead lines to be cleared away, and the Council is urging on the Government the necessity of undergrounding the telegraph and telephone lines also. Altogether some 5,312,157 units were sold by the department; and 838 motors of 2455 H.P. are connected to the supply.

A decision was recently given in an appeal from a judgment of the High Court of Australia to the Privy Council in London. The question at issue was the right of the Corporation of Melbourne to charge alternative optional rates for electrical energy, namely, a flat rate of 4½d. per unit, and a rate of 7d. and 2d. on the maximum demand system. It was held by the Supreme Court that this mode of charging was illegal; the Corporation must charge one uniform rate, irrespective of the quantity of energy supplied or the time when it was taken. An injunction was granted restraining the Corporation from supplying energy otherwise, and in consequence an Act was passed by the Legislature of Victoria legalising the practice of charging for electricity or gas used for power and heating at a lower price than for lighting. The High Court of

Australia reversed the judgment of the Supreme Court, and on appeal the High Court's decision was upheld, the Committee of the Privy Council holding that there was no illegal preference under the system in question.

Bristol.—The returns of the Electricity Department for the year ending March 25th last show gross receipts amounting to £72,440, and working expenses of £31,354, leaving a gross profit of £41,086. Interest, sinking fund, and renewals (£2,500), absorbed £39,970, leaving a net balance of £2,899. The capital expenditure amounts to £713,968. The total output for the year amounted to 6,418,146 units, 2,966,579 being for lighting, 2,619,830 for power, and 831,737 for public lighting. The average price obtained was 2·63d. per unit. The maximum A.C. and D.C. load amounted to 5,378 KW., the load factor being 13·62 per cent., and the total works costs 1·093d. per unit. The Avonbank works has been extended, and turbo-generating machinery is being installed to meet the growing supply; two motor-generator sub-stations have been brought into use at Temple Back and Underfall Yard. Some 798 motors have been installed on consumers' premises, the aggregate H.P. of motors and heating plant amounting to 5,805; and the total equivalent 8-C.P. connections amount to 365,552.

Chichester.—Mr. Horace Boot, of 4, Great George Street, Westminster, S.W. (who is retained by the Tunbridge Wells Corporation as its consulting engineer), has been appointed consulting electrical engineer to prepare plans, specifications, &c., for the Chichester Electric Light and Power Co., Ltd.

Glasgow.—The fifteenth annual report on the electricity undertaking, for the year ending May 31st last, shows a gross revenue of £224,845, and a working expenditure of £106,235, leaving £118,609 gross profit. Interest and sinking fund absorbed £73,785, and £41,755 was written off for depreciation, the balance amounting to £3,069 going to the reserve fund, which now amounts to £20,536. The capital expenditure, less depreciation, amounts to 1½ millions. During the year some 25 million units were sold, an increase of 24 per cent. on the previous year's output; 9,758,231 units were sold for power purposes—3,302 motors of 19,805 H.P. being connected. The equivalent 8-C.P. connections amounted to 1,404,553, and the maximum load to 19,646 KW.; all these figures representing substantial improvements on the previous returns. The Fort Dundas station now contains some 18,000 H.P., and the Pollokshaws Road station some 16,000 H.P. of plant. The Springburn sub-station, containing 2,000 KW. of motor-generators, was brought into use for last winter's load. The total cost (generating, distributing and management) for the undertaking amounted to ·722d. per unit, and the gross receipts averaged practically 2d. per unit.

Heswall.—A private company has been formed to carry out a scheme of E.L. in the district, and already about 80 per cent. of the principal residents have promised to take a supply of electricity.

Huddersfield.—On the recommendation of the Electricity Committee, the B.C. has decided to carry out extensions and alterations of works and plant at a cost of £40,000, the expenditure to commence in 1908, and continue over 1909; about £10,000 of it to be paid out of revenue, or out of the depreciation and contingency funds, leaving the balance of £30,000 to be charged to capital account.

Application is to be made to the B. of T. for its approval to the three-phase system of supply, generating at 6,600 volts, and transforming to 400 volts upon power users' premises.

Lees.—The Board of Trade has revoked the 1902 electric light order.

Manchester.—The electrical installation at the cathedral is practically complete, some 800 lights being installed. Of this number 500 are of 32 C.P., and the remainder of 16 C.P. The work has been carried out by Messrs. Drake & Gorham, Ltd.

Oswaldtwistle.—The U.D.C. has declined to agree to a proposal by the Accrington Corporation, that it should apply, on behalf of the Council, for a provisional order to be transferred to the Corporation to enable the latter to supply electrical energy in the district.

Southend.—The E.L. Committee has recommended the T.C. to apply to the L.G.B. for a loan of £20,940 for a new condenser, engine, boilers, pumps, dynamos, and meters.

Todmorden.—The Electricity Committee has decided to recommend the T.C. to increase the charge for electric lighting from 3d. to 4d. per unit, and to reduce the charge for motive power, with a view to increasing the day load. The manager's estimate, after allowing for all contingencies, is that the actual cost of producing electricity is just over 3d. per unit.

Wakefield.—A L.G.B. inquiry was held on the 20th inst., relative to the City Council's application for permission to borrow £7,250 for electricity purposes. There was no opposition.

Whitehead (County Antrim).—At a special meeting of the Ratepayers' Association on the 23rd inst., estimates for the lighting of this improving seaside place were considered. Four schemes of lighting, electricity, gas, actylene gas, and petrolite were submitted. The estimate for electrical lighting varied from £2,200 to £2,163; gas, £2,640 (with a capital expenditure of £3,000); acetylene, £1,326 to £1,441; and petrolite, 40 lamps at £493, with an upkeep of £75 per lamp. After considerable discussion, the schemes and estimates were referred back to the Lighting Committee for further report. Whitehead is a rising watering place on Belfast Lough.

Willesden.—A L.G.B. inquiry was held on August 22nd into the application of the U.D.C. for sanction to borrow £4,068 to defray the cost of the sites for generating and sub-stations. It was pointed out that the ground was acquired in view of eventualities when the agreement with the North Metropolitan Electric Supply Co. expired. There was no opposition to the application.

Windsor.—The lighting of Windsor Castle by means of electricity has proved so successful that it has been decided to extend the installation by between 700 and 800 lights, Messrs. Drake & Gorham being the contractors.

TRAMWAY and RAILWAY NOTES.

Continental Notes.—GERMANY.—The city of Berlin, which uninformed members of the London County Council sometimes refer to as an example of progress in electric railway construction that ought to be followed in the English metropolis, is now being provided with a short trial section of the suspended electric railway system—after negotiations extending over a period of 10 years! It has required all this time to negotiate, to inspect the Elberfeld-Barmen suspended electric railway, to consider plans, to examine large models of the system exhibited at the town hall, and to discuss the question of the most suitable street for a demonstration of the method. Yet what does this decade of progress mean? Simply that the Continental Co. for Electrical Enterprises has been granted permission to establish a trial section of railway in the Brunnen-Strasse for the approval or disapproval of the municipal authorities. If the system should please the latter, it will be necessary to commence once again tedious negotiations as to where the railway should be allowed to be constructed for actual passenger traffic. But if the method should not meet with favour, the final result of 10 years' endeavours may well be imagined. The trial section, which has just been commenced in so far as concerns the road work for the foundations for the central supports which are to carry the elevated superstructure, will merely be 400 ft. in length, and be arranged along the centre line of the roadway, with the tramways immediately underneath on either side. A length of 150 ft. out of the total will be constructed of steel, whilst the remainder will be of wood, the two methods being selected by the municipal authorities to show how they respectively appear. It is expected that the undertaking will be completed in a very short time, and the fate of the system settled in one way or another.

Eccles.—We regret to learn from Mr. H. W. Angus, the borough electrical engineer, that our note on the result of the arbitration between the Salford and Eccles Corporations was incorrect in several respects, though we received practically identical statements from two sources. The following is the corrected version:—

Price asked by Eccles at the Arbitration—
1½d. per unit for the first 500,000 B.T.U. per annum.
1d. „ „ all over 500,000 „ „

Price offered by Salford at the Arbitration—
1·048d. per unit for the first 500,000 B.T.U. per annum.
½d. „ „ all over 500,000 „ „

Price awarded by the Arbitrator—
1½d. per unit for the first 500,000 B.T.U. per annum.
1d. „ „ all over 500,000 „ „

Prior to the arbitration, Salford did not offer a *fixed* rate of 1·35d. per B.T.U.; its offer was to pay Eccles a sum not greater than that at which it could obtain a supply from its own Electricity Committee. Last year this sum was 1·35d. per B.T.U. This year it is reduced to 1·30d., and no guarantee would be given that the sum would remain at either of these figures, or for a minimum annual consumption. The award is silent on the question of costs, but Salford has to pay its own costs.

Haslingden.—The result of the arbitration between the Haslingden and Rawtenstall Corporation and the Accrington Steam Tramway Co. concerning the new electric tramway system was made known on Friday last. For so much of the undertaking as belonged to the borough, the company asked for Haslingden £24,203. Sir Colin Scott Moncrieff, the arbitrator, awards £14,203, which includes the depôt and its land. From Rawtenstall, the company asked £7,375. They are awarded £4,252. The Corporations were ordered to pay costs. Haslingden is arranging with the company to continue the running of the cars until the end of the year. It proposes to commence electrifying the system as early after Christmas as the weather permits, and meanwhile is negotiating with Accrington and Rawtenstall Corporations as to through-running powers.

Heywood.—The annual statement shows that the profit on the tramways undertaking was £155. On the electric lighting account there is a profit of £241, against a loss of £696 a year ago.

Huddersfield.—A provisional order for the extension of the tramway system from Crosland Moor to Crosland Hill has been obtained, and the work is being proceeded with.

(*Continued on page* 347.)

AN ELECTRICAL INSTALLATION AT LEEDS.

MESSRS. GREENWOOD & BATLEY'S WORKS.

In the works of Messrs. Greenwood & Batley, Ltd.—Albion Works, Armley Road, Leeds—there are many things that would make for the electrical engineer a very interesting and profitable study. This is so because of the large operations that are proceeding there connected with the manufacture of electrical machinery and apparatus, and also because of the electrical installation by which the various shops are run. The first steps in the direction of electric driving were taken many years ago on a very small scale before the accumulation of convincing evidence now available was at hand, and some interesting examples of the machines then put in, and still running efficiently, were pointed out to us on the occasion of a recent run through the works. As those small and early attempts proved beyond dispute the adaptability, convenience and general success of the electrical method, the services of the electrical department have been again and again requisitioned to carry out extensions of the installation in substitution for older methods.

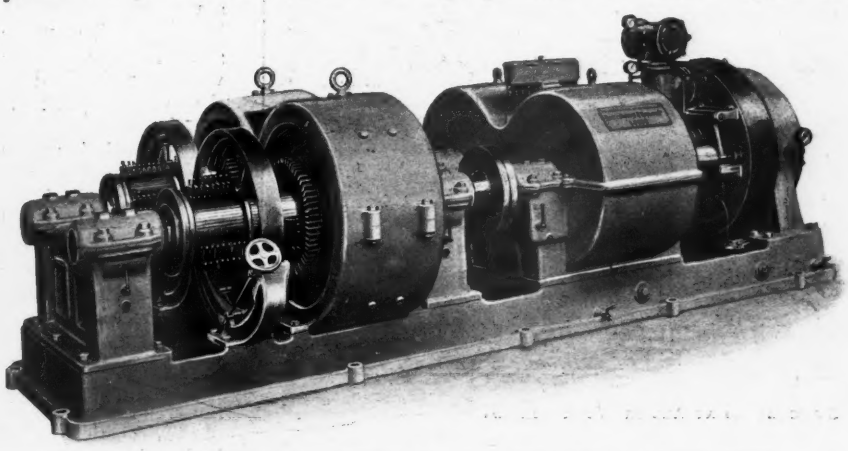


Fig. 1.—450-h.p. De Laval Turbine Set last installed at Albion Works.

If our readers will bear in mind the fact that Messrs. Greenwood & Batley make many other things beside electrical machinery, these including the De Laval patent steam turbines, machine tools of all descriptions, textile machinery, oil mill machinery, torpedoes, cartridges, &c., they may be able to grasp something of the varied nature of the applications to which electricity may be put in such a works.

The works to-day stand upon a site of about 13 acres, and there is a special branch line run in from the Great Northern Railway enabling railway trucks to be taken into every shop where heavy work is in progress.

The whole of the driving and the bulk of the lighting of the works is done electrically, the power being derived from two stations — one in Albion Works, and the other in the turbine department, which is outside the main works. The latter station was put down primarily because of the necessity of having steam for the testing of the steam turbines.

For electrically driving the Albion Works, power was originally derived from various small engines situated in the different departments, and, as may be imagined, a great loss was experienced, both in the shafting and steam pipes, owing to their length. At present there are 162 electric motors at work, ranging from 40 h.p. down to a fraction of a horse-power. As the change-over from steam driving to electrical driving has had to be carried out, the motors have been usually arranged for driving the existing machinery by means of short lengths of main shafting already installed, a 20-h.p. motor being usually taken as a unit, and the machinery driven

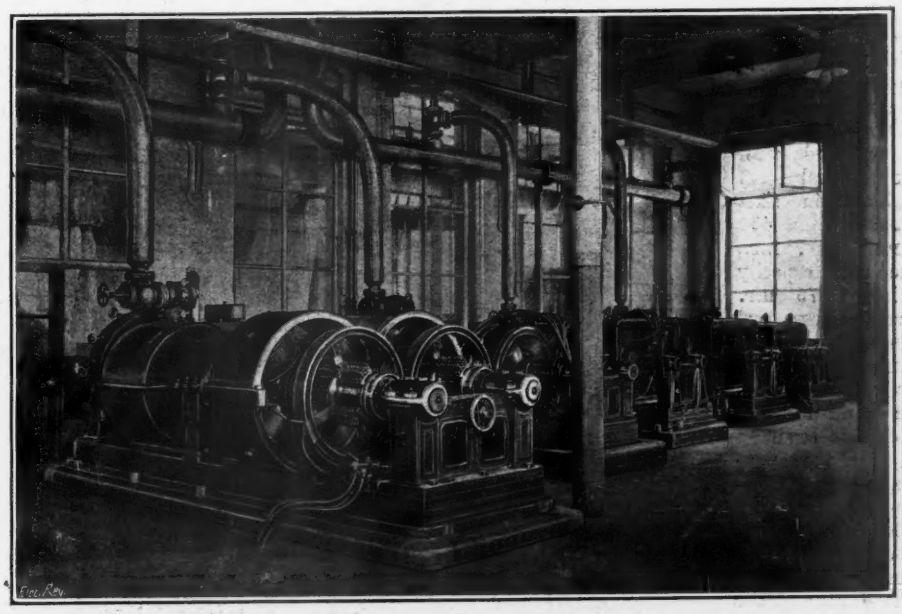


Fig. 2.—Power Station at Greenwood & Batley's Works. 1—300 h.p.; 1—225 h.p.; 1—150 h.p.; 1—100 h.p. and 1—75 h.p. De Laval Turbine Sets.

in groups. However, it has been found to be a great saving in power to have each machine tool driven by a separate motor, and in nearly all cases new tools are being so arranged.

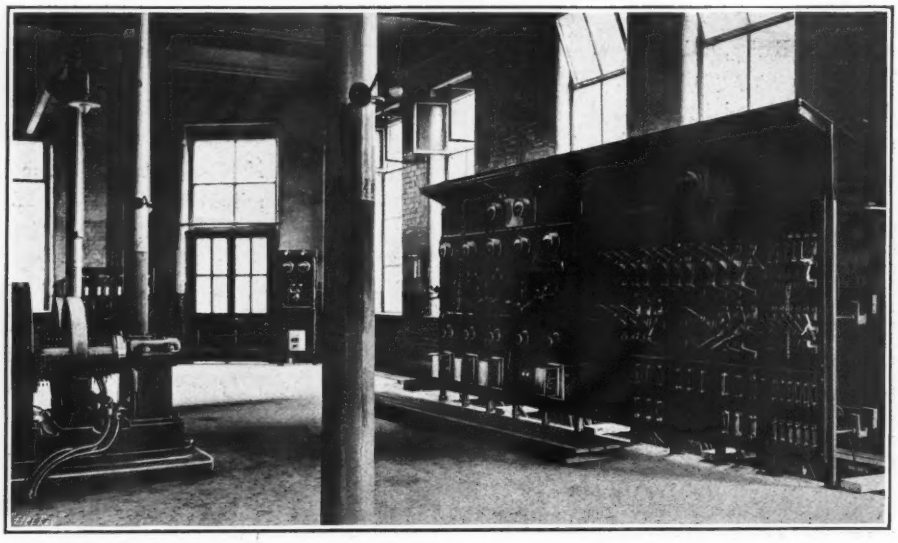


Fig. 3.—Switchboard at Albion Works, Leeds.

Main cables are run on cleats upon the roof standards to each department, where a distribution board is fixed and circuit cables are run to the various motors. Wherever possible, 60 to 80 H.P. is put on each circuit, and thus a standard size of circuit cable and distribution board is used throughout the works. Most of the lighting is done by means of enclosed arc lamps, the circuits for which are kept separate from the power circuits.

The power house is equipped with six De Laval steam turbines, in sizes ranging from 450 H.P. down to 75 H.P., the total capacity being 1,275 H.P. Each of these turbines drives double-armature direct-current dynamos. The general view of these sets is shown in one of the accompanying illustrations (fig. 2). The 450-H.P. set shown in fig. 1 has been put down since the photograph was taken. These machines supply power and light to the whole of the works, and are controlled by a simple and effective switchboard, each dynamo panel of which is fitted with a loose-handle circuit-breaker, ammeter, wattmeter and regulator, together with a voltmeter plug.

The various circuits for the works each have a single-pole switch and a double-pole fuse, and an ammeter shunt with plug connections to a common ammeter.

The turbine sets exhaust into a surface condenser having a cooling surface of 2,000 sq. ft. and a motor-driven three-throw air pump. In connection with this condensing plant, there is also an auxiliary dry air pump which gives an extra $1\frac{1}{2}$ in. vacuum, a very important factor in a turbine power station. The average vacuum maintained by the above plant is 27·7 in.

The circulating water for the condenser is pumped from the Leeds and Liverpool Canal by means of centrifugal motor pumps. These are situated in a separate pump-house by the canal side, but are controlled from the power station. Three sets are provided, the largest being capable of dealing with the usual load, and the other two being half the capacity. This power house is connected up with the smaller power house in the turbine department, so that if needful it can supply current to that department also.

Fig. 4.—A.C. Motor with Short-circuited Rotor.

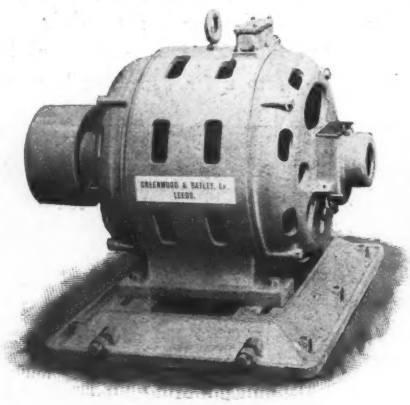


Fig. 5.—Semi-enclosed D.C. Motor.

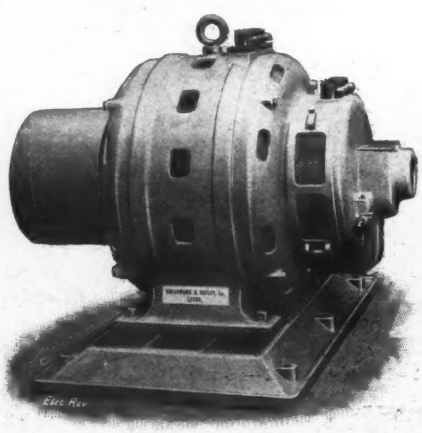


Fig. 6.—Semi-enclosed Slip-ring A.C. Motor.

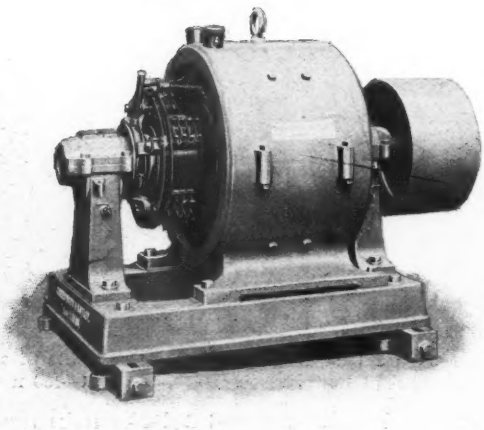


Fig. 7.—Open-type Motor.

The boiler house contains two Lancashire boilers 8 ft. 6 in. × 30 ft., and one Galloway boiler 6 ft. 6 in. × 26 ft. The latter boiler is worked at 80 lb. pressure, and supplies

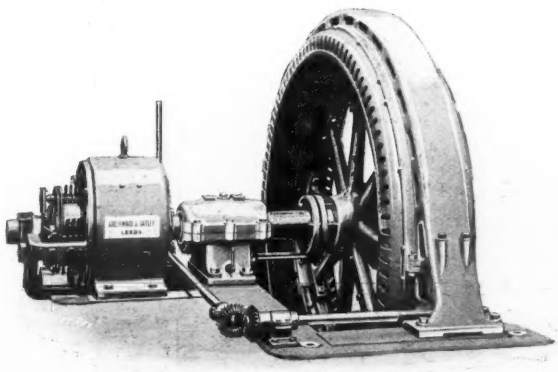


Fig. 8.—Two-phase Alternator and Exciter for Direct Coupling.

steam to the hammers in the smiths' shop. The two main boilers generate steam at 200 lb. pressure, and are hand fired. The steam is passed through a separately fired Schmidt's superheater where it is heated up to 580-600° F.

Induced draught is provided by means of a 25-H.P. motor-driven fan placed in the flue. The average draught thus produced is 1½ in. of water on the suction side of the fan. With this draught, one boiler is found to be quite enough to deal with the load.

The feed water is passed through a Schmidt's economiser with a heating surface of 2,200 sq. ft. where the temperature is raised from 90° F. (average of the hot well) to 295° F. (average of water entering the boiler).

A 7½-H.P. motor drives a three-throw boiler feed pump, which supplies all the water required by the boilers. The motor speed is capable of being varied from 550 revs. to 900 revs. A steam feed pump is also provided as a stand-by.

In regard to the output and cost of working of this installation, we are able to state that the number of Board of Trade units generated for the month of June was 105,939, while the working costs ran out as follows :—

No. of units	105,939
Coal	·211d.
Oil, waste, water, &c.	·015d.
Wages	·090d.
Repairs and maintenance	·070d.
Total works costs ...	·386d.
Load factor	38·5
Lb. of coal per KW.-hour	4·149

The above figures include day and night work. The latter, however, is intermittent and at very light load. If the night load could have been eliminated, the figures would have been far more favourable.

The turbine department is situated some little way from the main works, and is of modern construction. Here each machine has its own varying-speed motor, thus enabling the tools to be in the best positions for the easy handling of the work. Owing to the absence of all overhead shafting, the travelling cranes can lift heavy work on to the tools, thus saving much time.

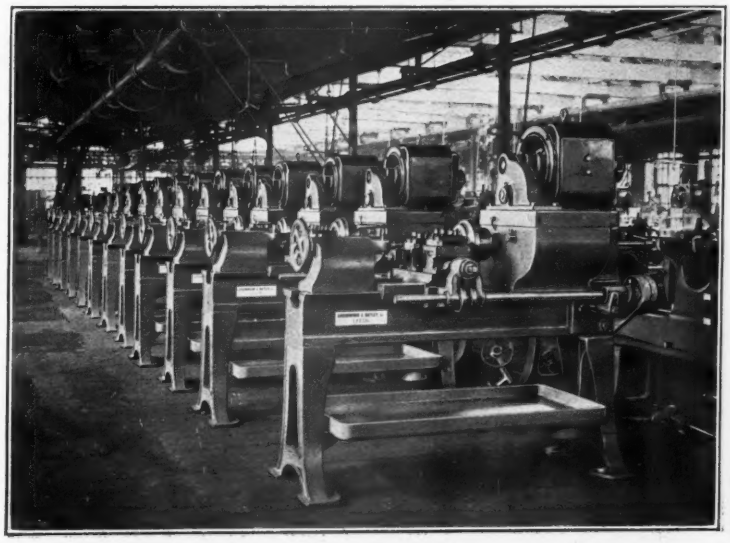


Fig. 9.—Row of Lathes fitted with Variable Speed Motors.

In the power station there are two 75-H.P., one 30-H.P., and one 7·5-H.P. De Laval steam turbines, which supply power and lighting to this department. In a recent test of the 450-H.P. turbine dynamo set already referred to, the steam consumption worked out at 19 lb. of steam per KW.-hr., or 13 lb. of steam per brake H.P. per hour.

In the other views appearing with this article we show examples of the firm's different electrical manufactures. In figs. 4 to 7 appear

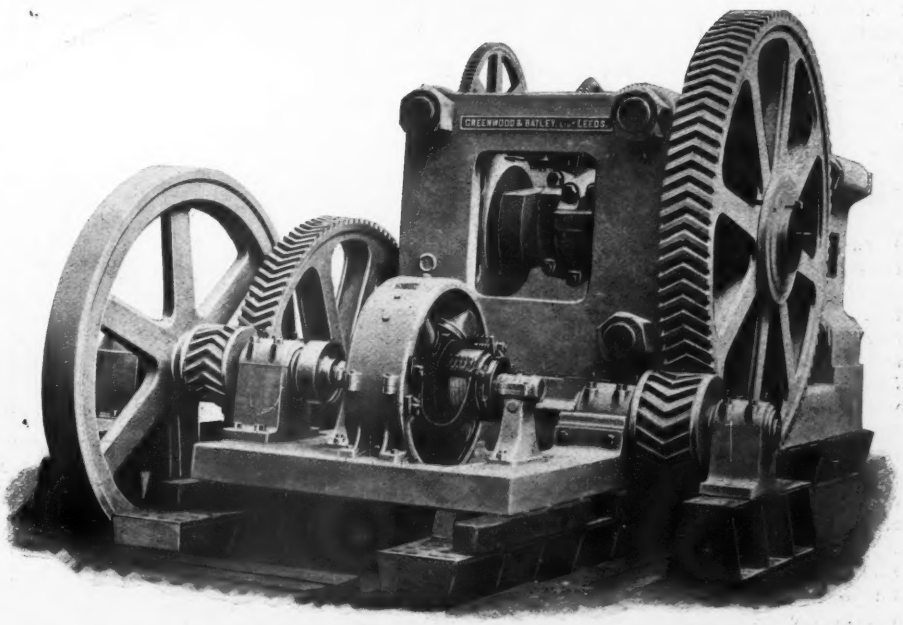


Fig. 10.—Electrically-driven Heading Machine for Putting the Heads on 10-Pounder Cartridge Cases.

four of their standard types of electric motors. Fig. 8 represents a two-phase alternator and exciter for direct coupling. In fig. 9 a row of their motor lathes, fitted with their variable speed motors, is illustrated, and in fig. 10, the application of an electric motor to a heading machine for putting the heads on 10-pounder cartridge cases appears. Fig. 11 shows an electrical excavator fitted with three motors (100 H.P., 50 H.P., and 25 H.P.).

We desire to express our indebtedness to the company for affording us an opportunity to visit the factory under the obliging pilotage of Mr. H. Hill, the chief of its electrical department, and for furnishing us with a good many of the particulars contained in the foregoing.

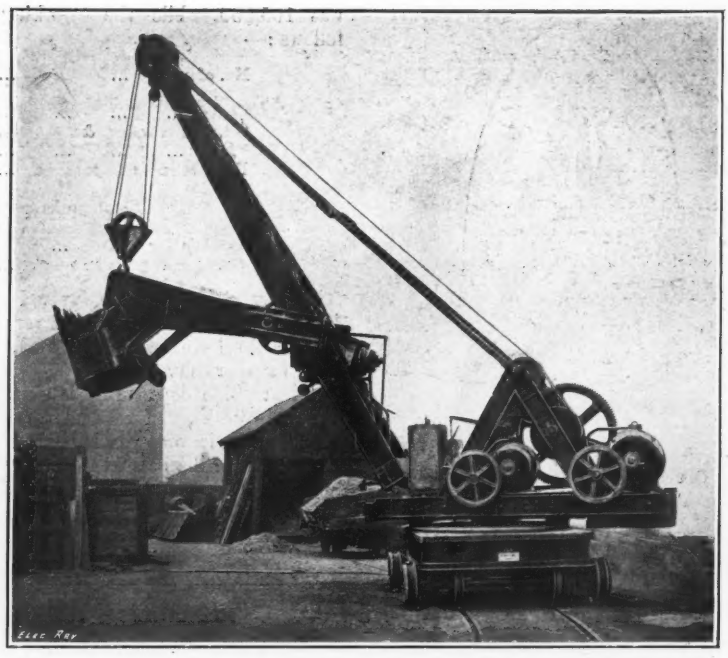
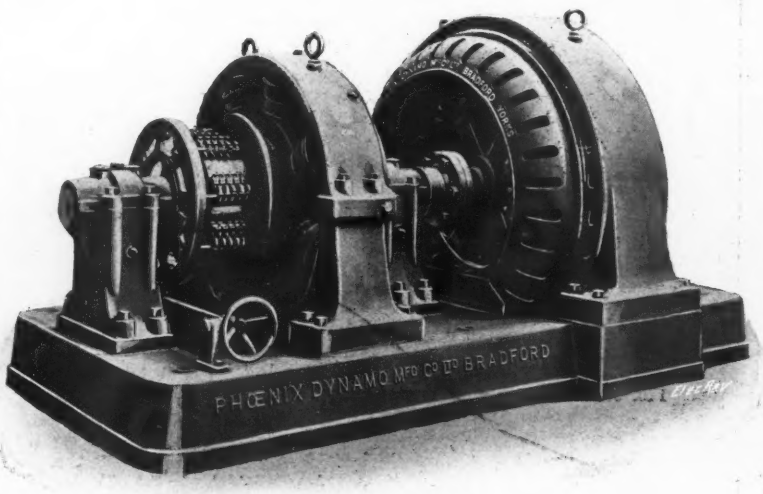


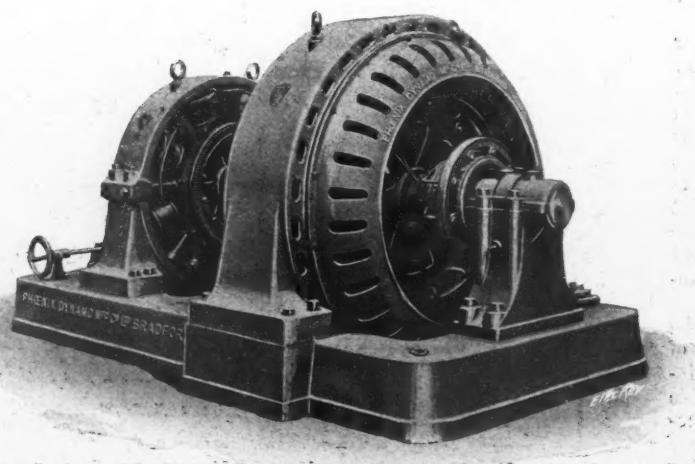
FIG. 11.—ELECTRICAL EXCAVATOR WITH THREE MOTORS, 25, 50 AND 100-H.P.

A NEW MOTOR-GENERATOR SET.

IN the accompanying photographs we show a motor-generator set which has just been completed and delivered to the Kent Electric Power Co., at Frindsbury, near Chatham, by the Phœnix Dynamo Manufacturing Co., Ltd., of Thornbury Works, Bradford. It is interesting as representing the transformation of three-phase power at 11,000 volts, 50 cycles, into 460 volts direct-current, by means of an induction motor-generator set without any static transformers, which, for comparatively so small an output, is unique. The output of the set is 220 KW. at 500 revolutions, the set being designed to have a very heavy overload capacity.



HIGH-TENSION MOTOR-GENERATOR: D.C. END.



HIGH-TENSION MOTOR-GENERATOR; A.C. END.

The three-phase current is generated at the Kent Electric Power Co.'s station at Frindsbury (which we described in our issue of June 21st, 1907) at 11,000 volts, and is transmitted to the works of Messrs. Cory Bros., where the motor-generator is to be fixed, a distance of about three miles away.

There being no current available for starting from the D.C. side, the employment of a low-tension induction motor, in conjunction with step-down transformers, was proposed. On the recommendation of the Phœnix Dynamo Co., however, a motor wound for the high pressure was employed, and the tests which the set has just undergone are stated to fully confirm the makers' recommendation.

The high stator pressure of 11,000 volts made extreme precautions necessary to guard against breakdown. Every tube in the stator was tested at the works of the makers at 25,000 volts, to earth, before putting into the stator, and after the winding was completed the whole stator winding was subjected to a pressure of 20,000 volts for a considerable period.

In order to guard against any possibility of a weakening of the insulation due to dampness, a new method of thoroughly impregnating the complete stator coils inside and outside the tubes was employed, which proved to be so satisfactory that it will in future be adopted by the makers for all similar work, and particularly for

mining machinery, which is one of the specialities of the P.D.M. Co.

It will be noticed that there is an apparent discrepancy between the size of the induction motor and of the generator, the former being somewhat large on account of the high voltage, whilst the direct-current generator is considerably reduced in size by the employment of the "Phœnix-Pohl" patent commutating poles. The rotor, of the slip-ring type, is wound for 500 volts, the starting being accomplished by means of a simple liquid starting device.

In order to compensate for any wear in the bearings, and also to assist in the adjustment of the rotor of the A.C. end in its stator, and the armature of the D.C. end in its fields, the carcasses of both machines are mounted on a bedplate in such a manner as to allow of their being adjusted in any direction and locked in that position, this method being specially advantageous in view of the very small air gap permissible in an induction motor.

TRAMWAY and RAILWAY NOTES.

(*Continued from page* 342.)

India.—CAWNPORE.—Some four miles of electric tramways were recently opened in Cawnpore, the route running through the chief thoroughfares and terminating at a celebrated bathing place on the Ganges. The cars are of the single-deck type, special compartments being reserved for ladies, and have Dick, Kerr equipments and double roofs, the latter being to minimise the effect of the 115° shade temperature, which often prevails. Messrs. Crompton & Co. were contractors for the whole of the installation.

Lastingham.—The promoters of the Lastingham and Rosedale Light Railway have applied to the B. of T. for an extension of time for carrying out the order.

London.—It is understood that Messrs. Dick, Kerr and Co. will commence the reconstruction of the Aldgate-Bow tramways on the G.B. surface-contact system about the middle of September, and that the contract will be completed in about 10 weeks.

LONDON TRAFFIC.—In Parliament last week Mr. Lloyd-George stated that the new branch of the Board of Trade would have no power to compel promoters to submit their schemes for preliminary examination before the deposit of Bills unless such submission should be required hereafter by an alteration of the Standing Orders. He did not anticipate that the absence of compulsory powers either in this matter or the taking of evidence would seriously interfere with the work of preliminary examination. The Board of Trade would make any communication which might be necessary as the result of such examination to the Parliamentary Committee which dealt with the matter. As regarded matters falling within the scope of the Home Office and Local Government Board, the Board of Trade was in communication with those departments and was assured of their co-operation.

L.C.C.—A report by the Astronomer Royal bearing on the trouble experienced recently at the Greenwich Observatory, in connection with the L.C.C. tramways, was issued last week. He points out that although the tremors caused by the generating station may be masked by the use of a thin film of mercury, it is a question whether they do not cause the telescopes to oscillate to such an extent as to interfere with the delicate work of which they are capable, such as the observation of close double stars. Further experience is required to decide this, as well as the effect on the accuracy of observations in the neighbourhood of the Greenwich Meridian, of the gases discharged from the chimneys of the Council's generating station; a further reduction in the height of the chimneys may be required to safeguard the Meridian work.

Keighley.—The annual report of this undertaking discloses a profit for the first time. The gross receipts amounted to £8,270, or 7·73d. per car-mile, and the number of passengers carried to 1,935,098. After meeting all charges, a net balance of £253 remained.

Maidstone.—The U.D.C. has decided, on the recommendation of its engineer, that Messrs. Dick, Kerr & Co. shall construct the Tovil extensions at the prices of their existing contract. The estimated cost of the work is some £7,500.

Manchester.—On Tuesday (27th) the Corporation Tramways Committee decided to recommend to the City Council that experiments be made with a view of establishing a slight reduction in long-distance fares; that proper provision be made for enabling workpeople to return home in the evening at the rate charged in the morning, and that children not exceeding 15 years of age proceeding to and from school be permitted to have return tickets at single fare.

Musselburgh.—A meeting, with a view to discussing the tramway strike, was arranged for Tuesday last, at the instance of the B. of T.

Southend.—The T.C. has definitely decided to abandon the proposed extension of the electric tramways to Shoeburyness, and to apply to the B. of T. for an extension of time for the construction of the extension of the line to Croxton's Corner.

A loan of £6,974 has been applied for, for car-shed extensions.

TELEGRAPH and TELEPHONE NOTES.

The Amenities of Telegraph Poles.—We hear so much nowadays to the disparagement of telegraph poles that it is a relief to meet with an expression of opinion in their favour. A writer in the *Daily Telegraph* of August 26th defends them in an eloquent essay on the artistic effect of a telegraph line in a rural landscape, the romance of the thrumming wires, and the utility of the line as a guide in a strange land:—"A man who cannot see the nobility of the long line of tall giants crossing the bare shoulder of a distant hill has little of the artist and nothing of the poet in his constitution. Silhouetted against a sunset, they have their own especial value, and modern artists have not failed to see their beauty in less obtrusive places. They form a black thread in the embroidery of Nature, and only those who have studied embroidery know of what infinite use that black line is in art. It must be used sparingly, as sparingly as gold, but its effect is as noble, and far more refined. . . . No artist, except your early Victorian dilettante, would dare to leave the poles out. I have known men wilfully and with vast wisdom aforethought put them in were they never were."

Overhead Wires in London.—The Public Health Department reports that since 1899, when the Corporation commenced the supervision of the overhead wires in the City, 24½ miles of derelict wire have been removed. Last year 48 derelict wires were taken down, the total length being 2,193 yds. During 1906 the number of private owners of lines increased to 133, and the number of companies to 21. The total number of spans crossing public thoroughfares is now about 731,500, as compared with 699,300 spans in the previous year, and 260,000 in 1899. The National Telephone Co.'s wires increased by 1,526 miles.—*City Press.*

Telegraphic Interruptions and Repairs:—

		Interrupted.	Repaired.
Cables.			
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed..	Jan. 12, 1906 ..	..
Beissa-Issa and Beissa-Yemani (Yemen) ..		Oct. 29, 1902 ..	..
Tarifa-Tangier		Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)		Mar. 9, 1904 ..	..
Garachico-Santa Cruz		July 12, 1906 ..	..
Las Palmas-Arecife		Aug. 18, 1906 ..	..
Brest-Dakar		July 22, 1907 ..	..
Mole St. Nicholas-Cape Haytien		July 23, 1907 ..	Aug. 20.
Acors-Lagos		Aug. 11, 1907 ..	Aug. 24.
Para-Pernambuco		Aug. 21, 1907 ..	Aug. 22.
Maranham-Ceara		Aug. 21, 1907 ..	..
Landlines.			
Puerto-Barrios		Aug. 2, 1902 ..	..

Wireless Telegraphy.—The *Times* says:—"The Admiralty have issued revised regulations for the use of the Service wireless telegraph apparatus for the transmission of private messages, and for the dispatch of parcels to his Majesty's ships." At first sight this appeared to be a novel application of Hertzian waves, possibly akin to Madame Blavatsky's precipitation of solid bodies from the ether; unfortunately a later passage shows that the parcels are to follow the prosaic routine of the postal service Private messages, however, may be sent by wireless telegraphy to his Majesty's naval shore stations (not to Marconi or other private stations), the charge being limited to that due for their subsequent transmission over the ordinary telegraph lines.

Telegraphists' Strike in the U.S.A.—No material change has taken place in the position during the past week. In Canada the railway operators who went out returned to work when they were assured that they would not have to deal with messages for the United States.

Copper.—Judging by Messrs. Merton's mid-monthly report, visible supplies of the metal are on the increase, the total for August 18th being over 1,000 tons higher than that for July 31st. To this may in some measure be attributed the decline in price of standard, although in the present condition of the money market values can hardly be maintained on any commodity. The general feeling is that the price will go lower yet, but a figure must shortly be reached at which the buyer will again be tempted to come in. Stocks afloat from Australia show better by 700 tons on July figures. The output for Spain also shows an increase.

CONTRACTORS' COLUMN.

ABERDEEN.—Proposed new Technical College.

ACTON.—House in Rosemont Road, electric light intended. Hammack and Lambert, architects, 59A, Bishopsgate Street, E.C.

Eighteen villas in Bollo Lane, electric light intended. Thorn, Trehearne & Norman, architects, 45, Lincoln's Inn Fields, W.C.

ACTON GREEN.—Morning chapel at St. Alban's Church. E. Monson and Sons, Acton Vale.

AMBLE (Northumberland).—New County Council schools. C. Williams, secretary to the Education Committee, Pearl Buildings, Newcastle-on-Tyne.

ARDRISHAIG (N.B.).—Proposed Library Institute.

ASTLEY (Lancs.).—New mines for the Astley and Tyldesley Coal Co., Ltd. Also villa for the manager.

Brick works at Town Lane for the Clifton and Kersley Coal Co.

BEXHILL.—Important additions to the Parish Church. Rudd & Son, builders, Wharf Road, Grantham; Mr. Tapper, architect.

BEVERLEY.—Alterations to Norwood House for the Governors of Beverley High School for Girls. B. S. Jacobs, architect, Lincoln's Inn Buildings, Bowlalley Lane, Hull.

BIRKENHEAD.—North branch Library in Price Street. A. W. Street, architect, Hamilton Street, Birkenhead.

(Rock Ferry).—South branch library in Grove Road. J. R. Mewton, architect, 59, Hamilton Square, Birkenhead.

BIRMINGHAM (Edgbaston).—New Catholic Girls' High School, Vernon Road. H. T. Sandy, architect, 22, Greengate, Stafford.

New telegraph store. Apply to the Postmaster, Birmingham.

BLACKPOOL.—New municipal schools. W. Caves & Co., contractors, Blackpool.

BLYTH.—New general post office. J. Goulding, architect, Blyth; Lord Ridley, owner.

BODMIN.—Enlargement of Dunmere Mills. M. Oliver, architect, Bodmin.

BOLLINGTON.—New premises for the Bollington Conservative Club Whittaker & Bradburn, architects, Macclesfield.

BOLTON.—New church at Breightmet. R. Neil & Sons, builders, Manchester.

Blocks of buildings (including shops) in centre of town. T. E. Smith, architect, Central Chambers, Bolton.

BOSTON (Lincolnshire).—Extension of power station at the Docks, and plant for the T.C. (£7,500).

BOWDON (Cheshire).—New secondary school for the C.C. (£10,000).

BOWDEN, N.B.—Restoration of the Parish Church (£2,000).

BRISTOL (Bishopston).—New parish hall, "St. Michael's and All Angels" (£2,400). C. A. Hayes, builder, Thomas Street, Redcliffe, Bristol.

BUXTON.—New Cottage Hospital.

CHESTERTON (Cambs.).—Ward pavilion at the Isolation Hospital for the R.D.C. W. Wren, architect, 10, Castle Street, Cambridge.

CHISLEHURST (Kent).—New Council school in Oxford Road, Lower Borough. F. W. Crook, secretary to Kent Education Committee, Caxton House, Westminster, S.W.

CULCHETH (near Warrington).—Extensions and alterations at Daisy Bank Mills.

DERBY (Shardlow).—New laundry for the B.G. (£1,200).

DEWSBURY.—Laundry for the Dewsbury District Co-operative Association (£3,350).

DOVER.—New Post Office.

DUDLEY.—Guildhall in connection with the Roman Catholic Church. G. H. Wenyon, architect, Tipton; Oakley & Coulson, builders, Dudley.

DURHAM.—Proposed Northern Convalescent Home (£12,000).

EXETER.—Buildings for J. Heathcoat & Co., Tiverton. A. Fisher, Tiverton, solicitors.

FARNBOROUGH (Kent).—Enlargement to Council school. F. W. Crook, secretary to Kent Education Committee.

GLASGOW.—New Mitchell Library in North Street.

GOSPORT (Lee-on-the-Solent).—New County Council School for Hants C.C. W. J. Taylor, County Surveyor, the Castle, Winchester.

HERNE BAY.—New post office. Dann & Lucas, 23, Budge Row, Cannon Street, London, E.C.

HOLLINGTON (Sussex).—New school for the East Sussex County Council.

HYDE (Cheshire).—Extensions to Gibraltar Co.'s mills.

LEEDS.—Detached block for the electrical engineering department of the University.

Important extensions to the workhouse for the B.G.

LLANELLY.—Villa in New Road for D. Davies, Mansel Hotel. W. Griffiths, F.S.I., architect.

LONDON (Highgate).—R.C. schools (£4,000) in connection with St. Joseph's Retreat, Highgate Hill.

(Regent's Park).—Flats in Albert Road. J. W. Falkner & Sons, Ossory Road, Old Kent Road, S.E., builders.

(Maida Vale, N.W.).—Shops. Leopold Farmer & Sons, 86, Gresham Street, E.C., agents.

(Maida Hill West, N.W.).—Flats. Barnard & Co., 71 and 72, Strand, W.C., agents.

(Regent's Park).—Flats in Clarence Gate Gardens. Chas. Wall, Ltd., 4, Lloyd's Avenue, E.C., builders.

(Piccadilly Circus).—Buildings at corner of Coventry Street and Rupert Street. A. Pannell, 104, Fentiman Street, S.E., contractor.

(Hornsey).—Primitive Methodist school-hall, in connection with Centenary Church.

(St. Bride Street, E.C.).—Alterations to No. 19 (former offices of the *Echo*). Geo. Andrews & Co., 39, Craven Street, Lancaster Gate, W., builders.

(Barking).—Commercial Inn to be rebuilt. Messrs. Charrington, owners.

(Stratford, E.).—Coach and Horses Inn to be rebuilt.

(Plumstead, S.E.).—Enlargement, &c., of parish church (£8,000). Rev. Hugh Lambert Ogle, Vicarage Road, Plumstead.

(South Kensington).—Hotel in Brompton Road. H. C. Clarke, 63, Bishopsgate Street Within, E.C., architect.

(Edgware Road, N.W.).—Rebuilding No. 431 for Hagger & Co., butchers, 397, Edgware Road.

(High Street, N.W.).—Shops. J. W. Falkner & Sons, Ossory Road, Old Kent Road, S.E., builders.

(Whitechapel).—R.C. schools (£7,650). W. P. Ryan, Whittington Avenue, E.C., architect.

LONGTON (Staffs.).—E.L. to be installed in St. John's Church.

MAIDENHEAD.—New "Ada Lewis" wing to Maidenhead cottage hospital (£1,500). E. J. Shrewsbury, architect, Maidenhead.

MIDDLESBROUGH.—Extensions and alterations to "Hugh Bell" Council schools. J. M. Bottomley, Son, & Wellburn, architects, 28, Albert Road, Middlesbrough.

MALTON (Yorks.).—New grammar schools. W. Hall, secretary to the Governors.

MANCHESTER.—Extensions to Ducie Avenue municipal schools (£5,000).

(Clayton Bridge).—Extensions to Home of the Little Sisters of the Poor (£10,000). O. H. Hill, architect, Manchester.

(Cheetham Hill).—New United Methodist church and schools. G. E. Tonge & Campbell & Fairhurst, architects, Lord Street, Southport.

MARGATE (Cliftonville).—New bank premises for the London and County Banking Co. C. J. Reeve, architect, Grosvenor Place, Margate.

MIDDLESBROUGH.—New railway stations at South Bank and Eston for the North-Eastern Railway Co.

MONAGHAN (Co. Monaghan).—New Post Office. W. H. Stephens & Sons, architects, 13, Donegall Square, Belfast.

MYTHOLMROYD.—Rebuilding Upper Brierley Mill. John Riley, Mytholmroyd.

NEWCASTLE-UNDER-LYME (Staffs.).—Villa residence in Clayton Road. T. H. James, architect, 3, Brunswick Street, Newcastle-under-Lyme.

OLDHAM (Royton).—Extensions to Congregational Church (£1,600). T. W. Jenkins, architect, 25, Queen Street, Oldham.

(Upper Mill).—New ring spinning mill. Viaduct Mill Co., Ltd., owners.

New mill projected, to be called "The Mitre."

PORTSMOUTH.—Four villa blocks to be added to the Borough Asylum (£24,000). Rake & Cogswell, architects, Prudential Buildings, Portsmouth.

PRESTWICH.—Block of shops. Richards & Willan, builders, Seedley Park, Manchester.

New Primitive Methodist Church.

REDHILL (Earlswood).—Extensions to the Royal Asylum for Imbeciles (£6,000).

ROTHERHAM (Mexborough).—New public hall and shops in Main Street. Mr. A. Lee, agent for Rev. R. Lee, Mexborough.

ROYTON (near Oldham).—Congregational Church extensions and new classrooms. Mr. Jenkins, Oldham, architect.

ST. ANNES-ON-THE-SEA (Lancs.).—Extension of the Pub'ic Offices for the U.D.C. (£1,000). Mr. Muirhead, architect.

SCUNTHORPE (Lincs.).—Higher Elementary School and Pupil Teachers' Centre for Lindsey C.C. Scorer & Gamble, architects, Bank Street Chambers, Lincoln.

SHEFFIELD (Walkley).—Council school premises (£2,130). H. L. Paterson, architect, 19, St. James' Street, Sheffield; J. & H. Wheen, builders, 37, Porter Street, Sheffield.

(Malin Bridge).—New Council schools (accommodation, 400). Potter & Sandford, architects, 16, St. James' Row, Sheffield.

Extensive additions to Victoria Station (Great Central Railway).

SMETHWICK.—New hospital in Holly Lane (£20,000).

SOUTHAMPTON.—New Petty Sessional Court at Alton. W. J. Taylor, county surveyor, The Castle, Winchester.

SOUTHEND.—Congregational church. Rev. D. Ewart James, Clifftown Church, chairman of Building Committee.

SOUTHEND-ON-SEA (South Church Beach).—New Congregational schools and hall (£,1550). Burles and Harris, architects; F. E. Woodhams, builder, Southend.

SOUTH SHIELDS (West Harton).—New Wesleyan church premises (£1,250). T. A. Page & Son, architects, South Shields; A. Ridley, builder, South Shields.

STOCKPORT (Chinley).—New church, "St. Mary's." J. W. Swindells, builder, New Mills.

SUNDERLAND.—New "Picture Palace," to be erected by Ralph Pringle.

SWALWELL (Co. Durham).—New co-operative stores. Swalwell Co-operative Society, Ltd., owners.

TINSLEY (Sheffield).—Buildings for the Methodist New Connexion Church.

UNSWORTH COLLIERY, WASHINGTON (Co. Durham).—New Primitive Methodist Sunday schools (£1,000). J. W. F. Phillipson, architect, Newcastle-on-Tyne; Robert Bruce, builder, New Washington.

WESTCLIFF.—Congregational church. Rev. D. Ewart James, Cliftonian Church, chairman of Building Committee.

WEYMOUTH.—Railway station, &c., for the London and South-Western Railway Co. Cleveland Bridge and Engineering Co., Ltd., Darlington, contractors.

WHITLEY BAY.—New pier, theatre, concert hall and pavilion.

WHITWORTH (Lancs.).—New doubling mill for the Dura Doubling Co. (a new company).

WIMBLEDON.—New church at the Park (£5,000).

WINDSOR.—New barrack block at the Victoria Infantry Barracks. H. B. Measures, director of barrack construction, War Offices, 80, Pall Mall, S.W.

YORK.—New clothing factory electrically equipped to be established at Fulford by a Leeds firm.

New secondary school for girls and pupil teachers' centre for the T.C. Mr. Brierley, architect.

Behaviour of Calcium Cyanamide on Storage.—A recent issue of the *Chemiker Zeitung* contained a short note by Dr. H. von Feilitzen, of Jönköping, in Sweden, describing the manner in which the variety of calcium cyanamide made according to the Polzeniusz process at Westeregeln is liable to deteriorate on storage owing to its hygroscopicity. Patents were taken out some time ago by Polzeniusz for a process of making calcium cyanamide according to which the calcium carbide was mixed with a certain proportion of calcium chloride before being heated and treated with nitrogen. The effect of this addition was to lower the temperature at which the calcium cyanamide was obtained, and generally to improve the conditions of manufacture. The calcium chloride, however, being only a kind of flux, remained unchanged in the finished material, and being an extremely deliquescent body, caused the calcium cyanamide to deteriorate on storage. This defect has already been mentioned and made the subject of patents. Herr O. F. Carlson, of Stockholm, indeed, has obtained protection (Eng. Pat. 15,445, July 7th, 1906, date claimed under International Convention February 28th, 1906) for a process of making cyanamide in the presence of one or more fluorides of an alkali or an alkaline-earth metal, with also, if desired, a sulphate of an alkali or an alkaline-earth metal. The object of these additions was distinctly stated to be an avoidance of the defect of deliquescence when calcium chloride was used. The calcium fluoride acts in other respects like the corresponding chloride, and enables the reaction between the calcium carbide and the nitrogen to proceed at a lower temperature than it otherwise would.

CONTRACTS OPEN and CLOSED.

OPEN.

Aldershot.—September 18th. Cable, troughing, and insulators for the U.D.C. for electric light extensions. See "Official Notices" to-day.

Bohemia.—September 14th. The railway authorities at Prague require tenders for electrically-driven tools with motors varying from 5 to 12 H.P.

Bristol.—Converters, switchgear and cables for the T.C. See "Official Notices" August 9th.

Cardiff.—September 14th. The Guardians invite tenders for provision of telephones, necessary wiring, switchboard, &c., and alteration of present telephone service at their Cardiff and Ely Workhouses. A. J. Harris, Clerk, Union Offices, Queen's Chambers, Cardiff.

Clonmel.—September 7th. Electric lighting of the District Lunatic Asylum. Section 1, suction-gas plant, engines and dynamos. Section 2, accumulators, switchgear, mains, wiring and fittings. Section 3, buildings and foundations. See "Official Notices" August 9th.

Croydon.—September 9th. Overhead material for Corporation tramways. See "Official Notices" August 23rd.

Dartford.—September 4th. Fire alarms and telephones at Gore Farm Hospitals for the Metropolitan Asylums Board. See "Official Notices" August 23rd.

Dublin.—September 9th. Cables for the Lighting Committee. See "Official Notices" August 23rd.

Egypt.—November 1st. The Alexandria Harbour authorities require tenders for the construction of an electric power station and for the following plant, to be worked by electric power:—Five transporters of large range; five ditto of smaller range; six cranes of 4 tons each; 36 cranes of 2 tons each; 25 capstans; cables, feeders, &c. Particulars may be obtained from the Directeur des Postes et Phares.

Erith.—September 4th. Overhead mains extension for electricity supply for the U.D.C. See "Official Notices" August 23rd.

Farnworth (Bolton).—Proposed extension of local electricity works, or putting down of additional machinery. Mr. R. B. Leach, electrical engineer.

Finchley.—August 31st. Surface condensing plant for the U.D.C. electricity works. See "Official Notices" August 16th.

Finchley.—September 16th. Feeders, mains and other cables; network and joint boxes for the U.D.C. See "Official Notices" August 16th.

France.—The municipal authorities of Bergerac (department of Dordogne) have invited offers for the concession for the electric lighting of the town during a period of 30 years.

France.—September 3rd. The Under-Secretary for Posts and Telegraphs, 103, Rue de Grenelle, Paris, requires tenders for electric cables in 12 lots, 5 of which consist in the remaking of old cables.

France.—September 7th, 8th and 9th. The Post and Telegraph Department requires tenders (1) for 19 lots of electric cables, paper-insulated. Tenders by September 7th. (2) Galvanised iron square troughs, &c., 17 lots. Tenders by September 8th. (3) Iron and steel accessories for telegraph and telephone construction. Tenders by September 9th. Particulars may be obtained from the Under-Secretary, 103, Rue de Grenelle, Paris.

Llandudno.—September 2nd. Supply and erection of battery, booster, &c., for the pier company. See "Official Notices" August 9th.

L.C.C.—October 8th. Three electrically-driven boiler feed pumps (each 9,000 gallons per hour capacity) for the East Greenwich tramway generating station. See "Official Notices" to-day.

London (G.P.O.).—September 9th. Creosoting red fir telegraph poles for the G.P.O. S. C. Hooley, Controller of Stores, Bedford Street, W.C.

Manchester.—September 7th. Laying underground telephone pipes, &c., for the Corporation. Specifications from the City Surveyor's Office, Town Hall (two guineas).

New South Wales.—September 25th. The Postmaster-General requires tenders for 12 tons of hard-drawn copper wire (200 lb. per mile); 4 cwt. copper binding tape (150 lb. per mile), $\frac{5}{32}$ wide; 4,000 best large white porcelain insulators; 3,250 tallow-wood cross-arms, 3 ft. 10 in., with end bolts complete. Tenders to G.P.O, Sydney, by September 25th (by wire).

New Zealand.—The T.C. of Napier requires tenders for a complete electric lighting, tramway and power installation.

Oystermouth.—The U.D.C. is inviting applications from those willing to establish an electrical undertaking there. See "Official Notices" August 9th.

Paris.—October 24th. The Municipal Waterworks Department (Service des eaux, canaux et égouts) requires tenders for the supply and erection at the Austerlitz works of (1) four sets of motor-driven pumps, dynamos, &c., complete, capable of lifting 100,000 cubic metres of water per day into either of two reservoirs, or 50,000 cubic metres into both at the same time; (2) and one reserve set; (3) 10 boilers in two groups of three and one of four. Particulars may be obtained at the Hotel de Ville.

Portugal.—September 4th. The Camara Municipal do Concelho de Ovar is inviting tenders for the supply of electric light for the public and private lighting of Ovar. Conditions at once from the Bureau of the Camara Municipal do Concelho, Ovar.—*Board of Trade Journal.*

Queensland.—September 9th. The Deputy Postmaster-General requires tenders for the supply of lead-covered paper-insulated telephone cable, also various post and telegraph stores, telegraph and telephone instruments, parts, &c. Specifications of the above, and of a number of other contracts for telegraph and telephone material, may be inspected at the office of the Electrical Review.

Queensland.—September 30th. The Postmaster-General requires tenders at Brisbane by September 30th for telephones, Leclanché cells, coin attachments, Edison-Lalande cells, resistance coils, battery pole changers, operator sets, &c. Specifications may be seen at the offices of the Electrical Review.

South Africa.—The *British and South African Export Gazette* says that the East London Municipality has instructed its London agents, Messrs. Dyer & Dyer, Ltd., 17, Aldermanbury, E.C., to obtain fresh tenders from British firms for the tramway material required in connection with the extension of the local tramway system.

The Durban Municipality will shortly be in the market for rails and other tramway material. The London agents are Messrs. Webster, Steel & Co., 5, East India Avenue, E.C.

Salford.—Tenders will shortly be invited by the Tramways Committee (Mr. G. W. Holford, general manager) for cars of the single-truck double-deck type, with covers.

South Australia.—January 8th, 1908. One common battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria Street, S.W.

Southampton.—The Corporation requires sundry underground cables, conduits and earthenware troughs. See "Official Notices" August 23rd.

Spain.—The municipal authorities of Mollet (province of Barcelona) have invited tenders for the concession for the electric lighting of the town.

Sweden.—September 15th and October 1st. The General Direction of the Canal and Waterworks at Trolhattan, Sweden, are inviting tenders until September 15th, for the supply and erection of turbines of 10,000 H.P.; and until October 1st for three 350-KW. continuous-current dynamos, a 4,800-ampere-hour battery of accumulators, four three-phase alternators of 11,000-kilovolt-ampere capacity, 12 relays, regulators, switchboards, &c.

Swinton and Pendlebury.—September 5th. E.L. wiring for the council offices and public baths at Swinton, and the Town Hall at Pendlebury, for the U.D.C. See "Official Notices" August 23rd.

Victoria.—October 8th. Eleven sections of branching system metallic circuit switchboard for Melbourne Central Exchange. Specifications may be seen at the offices of the Electrical Review.

Victoria.—January 7th, 1908. The Postmaster-General requires tenders for 11 sections of a common-battery switchboard and 3,000 subscribers' telephones and other apparatus for the telephone exchange at Windsor.

Worksop.—September 4th. Low-tension cables, joint-boxes, &c., for the U.D.C. See "Official Notices" August 23rd.

CLOSED.

Bristol.—The tender of Messrs. Bruce Peebles & Co., Ltd., for two 500-kw. and one 300-kw. Peebles-La Cour motor-converters has been recommended for acceptance by the Electricity Committee.

Bury St. Edmunds.—The T.C. has accepted the tender of Messrs. Heenan & Froude, Ltd., for the supply of a refuse destructor at the E.L. works, at £2,270.

Dublin.—At the last meeting of the Corporation, the report of the Lighting Committee recommending the tender of Messrs. Ferranti, Ltd., for sub-station switchboard, at £2,068, and feeder panels, at £340, and the tender of the British Electric Transformer Co. for transformers, at £2,320, for acceptance, was adopted.

Ferryhill.—The P.C. has accepted the tender of Messrs. Bolckow, Vaughan & Co., for an E.L. installation for the streets at Dean Bank.

Gainsborough.—The U.D.C. has accepted the tender of Messrs. Meldrum Bros., Ltd., for the supply of a refuse destructor, at £2,197, this including £210 for an engine and dynamo supplied by Messrs. Marshall, Sons & Co., Ltd., of Gainsborough. Horsfall Destructor, Ltd., tendered at £2,120.

Southend.—The E.L. Committee of the T.C. has recommended the acceptance of the tender of Messrs. Ledward & Beckett for a Ledward's evaporative condenser of a capacity of 60,000 lb. per hour, at £7,443.

Stevenston.—The Mirrlees Watson Co., Ltd., of Glasgow, have just secured an order from Messrs. Nobel's Explosives Co., Ltd., Stevenston, for a complete installation for the utilisation of exhaust steam from high-speed reciprocating engines. The installation will consist of a Rateau Brown-Boveri turbo-generator, with a barometric counter-current jet condensing plant and cooling tower, together with the various accessories.

FORTHCOMING EVENT.

Wednesday, September 4th.—At Sheffield. Annual general meeting of the Institution of Mining Engineers.

NOTES.

Making Cotton Resemble Wool.—The German papers have recently described a so-called electrolytic process for making spun or woven cotton into a good imitation of wool or cloth. The process consists in dissolving one part of common salt and two parts of washing soda in water so as to obtain a solution having a specific gravity of from 1·015 to 1·020. This liquid is brought into a convenient vessel, raised to a temperature of 37° C., and submitted to electrolysis with a direct current of, according to the size of the vessel employed, from 5 to 500 amperes at from 75 to 500 volts. Into the electrolyte is first plunged a mass of wool or woollen fabric. During the passage of the current the wool undergoes a very thorough cleansing process, acquiring a remarkably soft and velvety touch. When all the dirt and natural grease have been removed, the wool is withdrawn from the liquid and the solution is run into a special vessel, where it is allowed to settle. When it has become clear it is returned to the electrolysing cell, the current is turned on as before, and an appropriate quantity of cotton is put in and allowed to remain there for from 15 to 20 minutes. By this treatment (so it is said) the cotton is brought to resemble wool in appearance, absorbing a certain quantity of the wool grease and animal matter. The finished cotton can then be mixed with wool, carded, spun into yarn, and used in the preparation of numerous articles of every-day use, *e.g.*, stockings, curtains, carpets. If preferred, similar goods can be prepared from the treated cotton by itself. It is claimed that the cotton acquires a good deal of strength; and, indeed, that a fabric composed of one thread of wool with two of the treated cotton is practically equal in quality to a fabric composed of two threads of wool and one of ordinary cotton. The fabrics are soft and smooth, and are said to wear better than ordinary untreated material. We cannot help thinking, however, that the process sounds somewhat far-fetched.

Russian Taxation of Electric Light and Gas.—It was mentioned in this journal some time ago that the Russian Government had under consideration a scheme for the imposition of an excise tax on the consumption of electrical energy and gas for illuminating purposes. The question, which was referred to a Government commission for investigation, has already been dealt with in Italy and Spain, which have raised revenue from such sources for several years past. It appears from the report of the Commission, that one of the principal objections put forward against the proposed tax has been on behalf of various industrial associations, which contend that the projected impost would tend to check the development of electric lighting in Russia, where this method represents 39·8 per cent. of the total lighting, as compared with 50·6 per cent. for petroleum and only 9·6 per cent. for gas. The Ministry of Finance, however, point out that such imposts as levied abroad have in no way prevented the extension of electricity. In Italy a law was passed on August 8th, 1895, levying a tax on electrical energy and gas used for private lighting and heating, but their use for street lighting, motive power purposes, and for industrial heating is exempt from the tax. The tax is imposed according to the quantity of energy and of gas actually consumed, and it has to be paid by the producers and suppliers, who are, however, authorised to recover the amount from the consumers. As shown by statistics, the tax has not hampered the development of the lighting industry in Italy, where it yielded £38,000 in 1896-7, £66,000 in 1899-1900, and £88,300 in 1901-2, although figures for later years are not readily available. The question was taken in hand at a later date in Spain, and a provisional law passed on June 28th, 1898, was made definite in March, 1900. This law placed a tax on electrical energy for lighting and also on gas and carbide of calcium used for lighting and heating purposes. The payment of the tax is made by consumers, who hand the amount due over to the supply works, which thus act as collectors for the Government, and receive for the work of collection 3 per cent. of the sum payable to the State. It is proposed by the Russian Ministry of Finance to levy the tax according to the Italian system, and at the rate of 4 copecks (1d.) per kw.-hour of electrical energy consumed, and 4 copecks per 100 cb. ft. of gas for lighting. The electric and gas supply works will charge the tax to consumers and show separately on the invoices the amount due for this purpose. It is proposed to introduce the tax at the beginning of next year, although the Government Commission suggest the desirability of levying only 2 copecks per kilowatt-hour instead of twice this sum as contemplated by the Ministry of Finance.

Q. E. D.

Has it ever been your kismet
'long your engineering road
To equip, p'raps run some station,
Mill or shipyard installation
With a jerky, changeful load?
Let's compare!

Cranes and sawmill, traction, haulage,
Pumps and heavy tools on top,
Line demand no estimating,
Intermittent, fluctuating,
Lamps alight all o'er the shop—
How prepare?

Row of boilers in commission,
Coal consumption very steep,
Where with averaged load quite clearly
Half the number boilers merely,
Easily could deal, and keep
Steam to spare.

Generator sets are piled on,
Run 'twixt no load and extreme,
Never know what peaks are trapping,
Wouldn't do to be caught napping;
Costly business to redeem
Wear and tear!

Lights are awful, incandescents
Twitching past all toleration;
Arcs for ever pumping badly,
Staff's and workers' comments sadly
Jeopardising their salvation—
Sheer despair!

Waste and troubles such as these
(Riddance well worth praying for)
Far from mere hallucinations
Are conspicuous facts in stations
Where they're tied up somehow, or
Don't care.

Storage Battery with Shunt-Booster
Can put right what is amiss;
Brought *our* costs down in a hurry,
No more ructions, no more worry,
Wrought this metamorphosis
Fair and square.

Wish we'd seen our chance years sooner,
And installed this combination,
Would have saved much treasure shining!
Still, there's no sense in repining—
Moral: "*Of* procrastination
Do beware."

L. Broekman.

Crossing Niagara.—The City of Buffalo is supplied with electrical energy not only from two power stations on the American side of the Niagara Falls, but also from one on the Canadian side. The latter has recently been put in operation, and the *Electrical World* describes the novel system adopted for carrying the power cables across the river at Buffalo. The pressure is 22,000 volts, and there are two three-phase lines, 16 miles long, from the power station on the Ontario side of the Falls to a point opposite the terminal station in Buffalo. The distance between the supporting towers could

not be made less than 2,192 ft., and the minimum clearance permissible at the lowest point of the span was 131 ft. The heavy weight of copper cables would have necessitated very strong towers, while with aluminium cables the lower tensile strength imposed the use of a greater sag, and, therefore, higher towers. Further, the wide range of temperature entailed great variations in the sag, and with a deep sag there was supposed to be danger that the cables would swing into contact with one another during high winds—we say supposed, because doubt has recently been thrown upon the possibility of this contingency. In the event aluminium cables were adopted of 506,000 circular mils, each cable consisting of 61 strands; there are three circuits (one being a spare), each consisting of three cables supported at the corners of an equilateral triangle of 15 ft. side, with apex uppermost. The towers nearest the river are 212 and 215 ft. high respectively, and on the Canadian side there is an additional span of 1,668 ft., the third tower being 104 ft. high. At each of the terminal towers the aluminium conductors are dead-ended on electrose bobbin insulators connected with steel cables; the latter pass over large sheaves, and carry at their lower ends counterweights weighing 4,300 lb. each. By this means a constant tension in the span is ensured, providing for expansion and contraction and for storm stresses. The connection with the line is made through aluminium cable drop leads clamped to the span cables. At the intermediate tower the cables are interrupted, the ends being connected by steel chains 25 ft. long, which pass over saddles on the tower, insulated by electrose insulators. A slack cable of aluminium passes over the saddle connecting the span cables, while the chain carries the weight of the spans, and also relieves the conductors of the vibration and friction which might injure them.

The electrose insulators are a type which has been used by the Niagara Falls Power Co. for over four years, with satisfactory results for voltages up to 24,000 volts. They cost nearly twice as much as porcelain.

Live Rail Accidents in 1906.—It is satisfactory to find that the development of electric traction on the railways of this country is not being accompanied by a corresponding increase in the number of persons killed and injured through coming into contact with live rails. This conclusion is founded upon the statistics contained in the Board of Trade report on railway accidents for the year 1906. The report itself states that accidents of the live rail class have become less frequent than they were when electrical working was first introduced, and when the special danger which it involves was unknown. One reason for the improved state of affairs is afforded by the fact that precautions have been taken by covering the live rail at exposed places, by the use of better fencing and by the posting of warnings. The following table summarises the live rail accidents which took place in 1906:—

	Persons killed.	Persons injured.
City and South London	—	1
Lancashire and Yorkshire	1	7
London and South Western	—	1
Metropolitan	—	3
Metropolitan and Great Central Joint	—	1
Metropolitan & Great Western Joint	—	1
Metropolitan District...	1	1
North-Eastern...	2	6
Total	4	21

The total includes one railway employé killed and 10 injured, whilst injuries were received by one passenger and by two persons on business. The remaining three fatalities and eight persons injured were trespassers on the railways, notably on the electrical sections of the North-Eastern Railway. The figures for 1906 compare with two persons killed and 18 injured in 1905 and with eight persons killed and 20 injured in 1904, when only three of the above-mentioned railways were using electric traction. In addition to the cases already recorded, it appears that 16 railway servants and a person on business were injured by electric shock and burns not caused by direct contact with the live rail, and four persons were injured, one case leading to a fatal result, in generating stations associated with the railways in question.

The Manufacture of Carbon Tetrachloride.—It is interesting to note that carbon tetrachloride is now manufactured by an indirect electrical process, and this fact has probably had a large influence on the cheapness of this commercial product. It is well known that chlorine gas reacts with hot carbon bisulphide to produce the above-mentioned substance, and this reaction is considerably accelerated by the presence of sulphur dichloride. To secure a good even flow of chlorine gas the use of an electrolytic cell is to be recommended, which produces at the same time both caustic alkali and the product specially required. Both these substances are then utilised in the production of carbon tetrachloride. One of the best cells for this purpose is of the McDonald type. A battery of 75 such cells produces 1,500 lb. of chlorine gas per day and the same amount of caustic soda.

A direct method of producing this valuable solvent has been patented quite recently, and this appears to be quite feasible. The reaction rests upon the direct introduction of bleach and carbon into the vicinity of a strong electric current, the gas produced being condensed to remove the liquid products. In this manner the electric current supplies the energy necessary for the chemical change.—*Electrochemical and Metallurgical Industry*, Vol. V, No. 7.

Educational Notes.—Glasgow.—The Calendar of the Glasgow and West of Scotland Technical College for 1907-8 is one of the largest volumes of this kind that we have seen, containing 418 pages. It gives particulars of the various courses of study, and a brief account of the equipment of the laboratories. Prof. Magnus Maclean, D.Sc., is at the head of the Electrical Engineering Department. During the session 1906-7 548 students attended the day classes, and 4,381 the evening classes at the College. In Electrical Engineering there were 120 day students and 734 evening students.

University of London.—We have received the programme of University College for the session of 1907-8. In our last issue we described the extensive improvements and alterations which have been effected in the accommodation for students at this College. The programme gives full particulars of the courses of study, fees, scholarships, and other matters. Prof. J. A. Fleming, F.R.S., is the head of the Electrical Engineering Department.

Electric Shock Fatality.—An inquest was held at Marley Hill on 23rd inst. into the death of Joseph Willey (23), which occurred at Marley Hill Colliery on 21st inst. Mr. R. W. Berkley, who represented the owners of Marley Hill Colliery, stated that the deceased was engaged in looking after an electric pump, and received an electric shock, which caused death. The jury returned a verdict of "Accidentally killed by his hand coming in contact with the bar of the switch-box whilst working an electric pump."

Variation of Manganin Resistances.—In a paper read before the American Physical Society (reproduced in the *Electrical World*), Messrs. E. B. Rosa and H. D. Babcock give an account of an extended research carried on at the Bureau of Standards, on the variations which have been observed in the resistance of manganin resistance coils. These variations are negligible in the case of coils of 1 ohm or less, but become very important in coils of higher values, which are wound with finer wire. It was found that the resistance rose to a maximum in the summer, and returned to a minimum in winter, the variation amounting to from 15 to 25 parts in 100,000. This took place whether the coils were kept in air or in oil, and was not due to temperature changes. Experiments were made to determine the effect of atmospheric humidity upon the coils, with the result that the authors traced the phenomenon to the absorption of moisture from the atmosphere by shellac, in which the wire is deeply embedded. The shellac expands, stretching the wire and thus increasing its resistance. Dipping the coils in melted paraffin afforded a complete cure for the trouble. Sealing them in test tubes was also effectual, but immersion in oil did not give protection, for the oil absorbed moisture and transmitted it to the coils. Curves are given in the paper showing markedly the effect of intentional variations in the environment of various coils, and contrasting with this the constancy of coils kept in an atmosphere of unvarying humidity. Coils protected by paraffin, whether first shellacked or not, showed practically no change, certainly not more than 1 part in 100,000, in several months. The paraffin should be of high melting point, free from dirt and acid.

Heroult Electric Steel Process.—The following is a description of the method in use at one of the largest furnaces now in existence. Steel is made in an open-hearth furnace of a capacity of 25 tons, and is then refined in an electric furnace, 4 tons at a time, the daily output being 60 tons. In the electric furnace the treatment is complete in 1½ hours. From very exact tests the following details have been compiled:—200 kilowatt-hours are sufficient for treating a charge of 5 tons if the over-oxidised metal is supplied directly from the open-hearth furnace in a molten condition. If the price of the kilowatt-hour is assumed to be one-half cent.—which is possible in many steel works—the total electrical energy necessary for the treatment of 5 tons of steel does not exceed 4s., or about 20 cents per ton. If, however, the charge is introduced in a cold condition, the energy consumption rises enormously, and it becomes necessary to work alongside an open-hearth furnace. Since in the Héroult furnace the current passes from one electrode into the slag on the top of the metal, through the slag and out of it into the second electrode, it is important that the arcs should be playing properly between the electrodes and the slag. If a rod of steel in contact with the molten mass is connected to two outside circuits, either of which leads to one electrode, and contains one voltmeter, then each voltmeter is in shunt with its electrode, the arc and the fused metal, and indicates whether there is the proper valtage between the electrode and the metal. The indication of the voltmeter may be directly applied to automatic regulation of the position of the electrodes by electromagnetic means.—*Electrochemical and Metallurgical Industry*, Vol. V, No. 7.

Parliamentary.—The following have received the Royal Assent:—

Aberdeen Corporation Electricity Act.
Oxford and District Tramways Act.
L.C.C. (Tramways and Improvements) Act.

Sports.—The British L.M. Ericsson Manufacturing Co., Ltd., of Beeston, Notts, held their second annual sports on Saturday last at Beeston. There was a large and enthusiastic gathering, and at the conclusion of a successful programme the visitors were further entertained until dusk with an open-air concert, rendered by Messrs. Humber's prize band and a company of vocal artists.

Appointments Vacant.—A man for repair and testing of electrical instruments, &c., is required for the Royal Navy Yard at Gibraltar (59s. 6d., with quarters); electrical engineer for the Walsall electricity undertaking (£400).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. A. Wylie, the Walsall borough electrical engineer, has just accepted an important appointment in Auckland, New Zealand, where he will proceed in the course of a month for the purpose of laying down a complete new installation for the city of Auckland. Mr. Wylie has held his present position in Walsall for upwards of 12 years—from the inception of the electrical undertaking in the borough.

Mr. H. B. Woodford, a member of the staff of the Isle of Wight E.L. Co., has secured an appointment at the Shanghai Municipal E.L. Works, China, and sails on September 30th.

The Huddersfield T.C. has appointed Mr. Hilton Walker as engineer-in-charge at the electricity works.

Mr. Arthur E. Wilkins has resigned his position as electrical engineer to the borough of Monmouth, and is going to practise in Dublin as an electrical engineer and contractor. He is taking a former pupil (Mr. S. H. Burden) into partnership with him.

General.—On July 18th, at Sydney (N.S.W.), Mr. Fehon, one of the late Government Railway Commissioners, was presented with an address and a silver tea service, on his retirement from that position. Mr. Fehon is in his 74th year, and has been appointed to chairman of the Royal Commission on Forestry. He had seen some 56 years' service in connection with railways, and 19 years ago was appointed to the Sydney Department of Railways, so that it is, of course, during Mr. Fehon's period of office that so much important work in connection with the electrification of the tramways has been carried through.

Mr. Joseph Berliner, the former owner of the Telephonfabrik J. Berliner, of Hanover, and the general director of the company since its formation, has recently retired from this position in consequence, it is stated, of differences with the other directors. It appears that before the death of the vice-chairman of the company, the latter was controlled by German interests, but the decease of that gentleman has thrown his shares on the market. These have been acquired by Austrian interests, and the Vienna directors now control a majority of the shares in the Hanover company.

We learn that Mr. W. H. Booth hopes to be back at his office, 2, Queen Anne's Gate, S.W., in September, on his return from the U.S.A. and Canada.

NEW COMPANIES REGISTERED.

Dublin and Central Ireland Power Syndicate, Ltd. (8,228).—This company was registered in Dublin on August 16th, with a capital of £10,000 in £1 shares, to carry on in Dublin, County Kildare, King's County, Queen's County, and elsewhere, the business of an electric power and power gas supply company in all its branches. The first subscribers (each with one share) are:—E. J. Duff, Woodville Grange, Granard, County Longford, engineer; A. E. Mills, Marietta, Sandycove, County Dublin, civil engineer; J. Sturgeon, 36, Hollyshaw Lane, Whitkirk, near Leeds, civil engineer; T. Tomlinson, 16, Beresford Place, Dublin, civil engineer; J. T. Sturgeon, 36, Hollyshaw Lane, Whitkirk, near Leeds, civil engineer; S. Geoghegan, The Grove, Killiney, County Dublin, engineer; and H. Nelson, 4, South Parade, Leeds, solicitor. The number of directors is not to be less than three or more than seven; the first are E. J. Duff, A. E. Mills and J. Sturgeon; remuneration as fixed by the company. Registered office, 7, Westmoreland Street, Dublin.

Lighting and Heating Trust Co., Ltd. (94,687).—This company was registered on August 23rd, with a capital of £10,000 in £1 shares, to carry on, assist in and promote lighting, heating and other industries and undertakings, to act as trustees for the holders of debentures, bonds or debenture stock and as attorneys for the investment, loan, payment, transmission and collection of money, to subscribe for, underwrite, issue, hold, deal in and convert stocks, shares and securities, &c. The first subscribers (each with one share) are:—G. C. R. Harvey, St. Chads, Strawberry Hill, Middlesex, secretary; R. G. Pollock, 1, Church Court, Clement's Lane, E.C., solicitor; D. J. McIntyre, "Risca," Honor Oak Park, philatelist; W. J. Poole, 14, Dean Street, Islington, clerk; J. W. Walker, 85, London Wall, E.C., accountant; W. J. Walker, 85, London Wall, E.C., clerk; W. P. Ford, 85, London Wall, E.C., broker. No initial public issue. The number of directors is not to be less than three or more than five; the subscribers are to appoint the first; qualification, £100 shares or stock; remuneration (except managing directors), £100 each per annum, with £25 extra for the chairman, and 5 per cent. of the surplus profits after 10 per cent. is paid on the ordinary shares, divisible (such percentage not to exceed £2,500 in any year).

Huggett & Worthington, Ltd. (94,634).—This company was registered on August 19th, with a capital of £500 in £1 shares, to acquire the business of electrical and mechanical engineers and contractors carried on by H. P. S. Huggett and W. T. Worthington at 85, Bridge Street, Warrington, as "Huggett & Worthington," and to carry on the same and the business of manufacturers of and dealers in electrical plant, engines, vehicles, fittings and apparatus, &c. The first subscribers (each with one share) are:—H. P. S. Huggett, 85, Bridge Street, Warrington, electrical engineer; Mrs. E. Huggett, 85, Bridge Street, Warrington; W. T. Worthington, 85, Bridge Street, Warrington, electrician; T. Proud, 1, Mill Street, Warrington, accountant; W. A. Proud, Braystones, Frodsham, bank actuary; E. Macaulay, 579, Knutsford Road, Warrington, accountant; and J. A. Brookes, Darlington Lodge, Warrington, clerk. No initial public issue. Table "A" mainly applies.

Magnetic Clutches, Ltd. (6,614).—This company was registered in Edinburgh on August 24th, with a capital of £20,000 in £1 shares, to acquire from Harry W. Ravenshaw, V. G. Middleton and W. E. Townsend certain patents for the manufacture of magnetic clutches and change speed gears, and to carry on the business of manufacturers, proprietors, agents and brokers of and dealers in, motor-cars, vans, motor-lorries, motor-boats and other public or private conveyances, &c. The first subscribers (each with one share) are:—J. T. Townsend, 19, Huntly Gardens, Glasgow, distiller; W. E. Townsend, 21, Rutland Square, Edinburgh, engineer; F. P. Anderson, 1, Lynedoch Place, Edinburgh, chartered accountant; A. Barr, Caston Street, Anniesland, Glasgow, engineer; W. Mackinnon, 34, West George Street, Glasgow, chartered accountant; A. Morrison, 34, West George Street, Glasgow, clerk; and J. Harvey, 224, West Street, Glasgow, engineer. The number of directors is not to be less than two or more than seven; the first are J. T. Townsend, W. E. Townsend and W. Mackinnon; qualification, £500; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Dolter Electric Traction, Ltd. (London) (70,261).—Particulars of £50,000 5 per cent. debentures created by resolution of June 27th, 1907, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. Property charged: the company's undertaking and property, present and future, including uncalled capital. No trustees.

Tyer & Co., Ltd. (56,760).—This company's annual return was filed on June 23rd, when 22,007 shares had been taken up out of a nominal capital of £25,000 in £1 shares. £1 per share has been called up on 2,007 and £2,000 has been received, leaving £7 in arrears. £20,000 is considered as paid on the remainder. Mortgages and charges: Nil.

South African Lighting Association, Ltd. (27,609).—This company's annual return was filed on July 3rd, when 8,000 shares had been taken up out of a nominal capital of £100,000 in £10 shares. £10 per share has been called up on 7,895 and £78,950 has been received. £1,050 is considered as paid on 105. Mortgages and charges: £30,000.

D. Santoni & Co. (1906), Ltd. (electrical and general engineers, London), (89,277).—Issue on August 3rd of a debenture for £110, part of series created May 31st, 1907, to secure £2,750, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £2,640.

Robertson Electric Lamps, Ltd. (39,316).—This company's annual return was filed on August 8th, when 4,500 shares had been taken up out of a nominal capital of £50,000 in £10 shares; £44,000 has been received, and £1,000 is considered as paid. Mortgages and charges: £10,000.

Rowland Barnett & Co., Ltd. (40,774).—This company's annual return was filed on July 20th, when 5,509 shares had been taken up out of a nominal capital of £20,000 in £1 shares; £509 has been received and £5,000 is considered as paid. Mortgages and charges: £1,346.

London United Tramways, Ltd. (71,844).—Memoranda of satisfaction in full (*a*) of a second debenture dated November 28th, 1906, to secure £300,000, and (*b*) of an agreement to issue debentures, dated May 10th, 1907, securing an indefinite amount, have been filed.

A second mortgage debenture dated August 16th, 1907, to secure £300,000, has been registered. Property charged: The company's undertaking and assets, including uncalled and unpaid capital, but excluding certain building land adjoining the company's Fulwell depôt, and the Troy Town property at Brentford, and lands, tenements, and hereditaments already acquired or to be acquired in connection with street or road-widenings and improvements, subject to the first mortgage debenture stock. Holders: Parr's Bank, Ltd., Bartholomew Lane, E.C.

County Electric Traction Co., Ltd. (75,553).—This company's annual return made up to December 31st, 1906, was filed on June 21st, 1907. 1,050 shares have been taken up out of a nominal capital of £3,000 in £1 shares. 17s. 6d. per share has been called up, resulting in the receipt of £537 10s. £381 5s. remains in arrears. Mortgages and charges: Nil.

Chepstow Electric Lighting and Power Co., Ltd. (70,646).—This company's annual return was filed on August 26th, when 5,410 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £1 per share has been called up on 1,505, resulting in the receipt of £1,497. £68 remains in arrears. 3,905 shares are considered as fully paid. Mortgages and charges: £1,000.

CITY NOTES.

Charing Cross, Euston and Hampstead Railway Co.

The report for the half-year ended June 30th, states that the capital expenditure during the period amounted to £547,860. The work of construction having been substantially finished the directors thought it desirable that the railway should be opened for public traffic before the final completion, and an arrangement was accordingly made with the contractors, the Underground Electric Railways Co. of London, Ltd., which enabled the railway to be opened before it was handed over by the contractors. By this arrangement the contractors take all receipts and make all payments from the day of opening up to June 30th last, they paying the interest at the rate of 4 per cent. per annum on the issued debenture stock for the same period. The railway was opened for public traffic on Saturday, June 22nd, 1907. Upwards of 140,000 people availed themselves of this invitation to make free use of the line throughout the day, and were afforded the opportunity of becoming familiar with the route. A very frequent train service is being run from Charing Cross to Golder's Green, and from Charing Cross to Highgate. Through bookings are now in operation with the Baker Street and Waterloo, the Great Northern, Piccadilly and Brompton, the London and North-Western, the Midland, the South-Eastern and Chatham, and the City and South London Railways, and on September 1st through bookings will commence with the

Central London Railway, which will create a new through route to the City, *viâ* Oxford Street, in addition to the existing route, *viâ* Euston and the City and South London Railway. Prior to the opening of the railway, Sir George S. Gibb was elected a director and chairman of the company, and Lord George Hamilton, Sir Algernon West, and Mr. W. M. Ackworth, were elected directors.

Baker Street and Waterloo Railway Co.

The directors' report for the half-year ended June 30th, 1907, says that the expenditure on capital account during the period amounted to £54,865. The gross receipts on revenue account were £63,452. The working expenditure, including rates and taxes, has been £42,128. The passengers carried since the opening of the railway have been as follows:—

	Number, including estimated journeys by season ticket holders.
Half-year ending June 30th, 1906 (16 weeks)...	3,006,276
December 31st, 1906	6,799,895
June 30th, 1907	9,936,995

The balance of £6,745 at the credit of the net revenue account has been carried forward to next half-year, and will be available for increasing the dividend on the preference shares from 3 to 4 per cent. if the net profits of the next half-year with the amount so carried forward are sufficient to pay the higher dividend. The directors have decided to postpone the commencement of the construction of the Paddington extension, and an agreement with the Underground Electric Railways Co. of London, Ltd., dealing with this matter will be submitted to the shareholders for approval at the meeting. The agreement also defines the liability of the Underground Electric Railways Co. of London, Ltd., for interest and administration expenses, by providing that they shall be deemed to have undertaken and shall undertake to guarantee the payment of debenture interest, and also a dividend at the rate of 3 per cent. per annum on the share capital, until the postponed works mentioned in the agreement, including the Paddington extension (unless such works or any of them are meanwhile abandoned by the company), are ready for opening for traffic. The report refers with regret to the death of the chairman, Mr. Theodore J. Hare, and that of Sir Benjamin Baker, one of the constructing engineers of the company. Sir George S. Gibb has been elected chairman.

Mersey Railway Co.

The directors' report for the half-year ended June 30th, to be submitted to the half-yearly meeting at Worcester House to-day, 30th inst., says that the train mileage run during the half-year was 411,313 miles, as compared with 412,633 during the corresponding six months of 1906. The number of passengers conveyed during the half-year ended June 30th, 1907, has been 5,618,462, as against 5,252,867 for the corresponding period of 1906, exclusive of season ticket holders. The total receipts from all sources for the half-year have been £49,892, as compared with £47,129 for the corresponding period of 1906. The working expenses, exclusive of the charges for pumping, ventilation, and lifts, have been £31,418, equal to 62·97 per cent., as against £31,120, equal to 66·03 for the corresponding six months. These charges for pumping, ventilation, and hydraulic lifts for the past half-year amounted to £4,059, equal to 8·13 per cent., as compared with £3,926, or at the rate of 8·33 per cent. for the corresponding period of 1906. The directors regret that the appeal of the Birkenhead Corporation to the House of Lords in the action at their instance with regard to the motor omnibus service of the company has resulted in the reversal of the judgment of the Court of Appeal and the consequent stoppage of the service.

Great Northern, Piccadilly and Brompton Railway Co.

The report for the half-year ending June 30th, shows that the capital expenditure during the half-year amounted to £165,462. The gross receipts on revenue account amounted to £106,570, and the working expenditure (including rates and taxes) has been £75,794. The number of passengers carried since the opening of the railway is as follows:—

Half-year ending	Number, including estimated journeys by season ticket holders.
December 31st, 1906 (16½ days)	806,120
June 30th, 1907	11,953,759

The deficiency of £5,270 on the net revenue account after paying all rents, rent charges and interest on debentures issued and sold, has been paid by the Underground Electric Railways Co. of London, Ltd., under their guarantee agreement. Warrants for the guaranteed dividend at the rate of 4 per cent. per annum on the share capital were sent to the shareholders on August 2nd. A resolution confirming this dividend will be submitted to the meeting on September 4th. The work on the Holborn to Strand section of the company's railway is nearly completed, and the directors expect to open that section for public traffic in December. The opening of the "Hampstead" Tube will, it is expected, create a new and valuable traffic for this railway by means of the convenient interchange afforded at the Leicester Square station, enabling passengers to get quickly to Camden Town, Hampstead, Golder's Green and Highgate. Through bookings have been arranged between the two railways.

Companies Struck off the Register.—The names of the following companies have been struck off the register:—

Albert Electric Lighting Co., Ltd.
Automatic Smoke Prevention Syndicate, Ltd.
British Electric Installation Contractors, Ltd.
City of Bath Electric Lighting and Engineering Co., Ltd.
Collier Audible Telephone Syndicate, Ltd.
Epstein Electric Accumulator Co., Ltd.
Fowler Insulator Syndicate, Ltd.
Home Telephone Co., Ltd.
International Electric Syndicate, Ltd.
Lithanode and General Electric Co., Ltd.
Lodge Electric Light and Power Co., Ltd.
London Lighting and Engineering Co., Ltd.
New British Electric Installation Contractors, Ltd.
R. C. Cutting Douglas & Co., Ltd. (Registered May 11th, 1892.)

The following will be struck off in three months unless cause is shown to the contrary:—

Newington Priddle & Co., Ltd.

Puebla Tramway, Light and Power Co. — We are informed that the control of this company has been acquired by a strong London syndicate, headed by Sir Weetman Pearson, of S. Pearson & Son, Ltd., contractors. The transaction involves the consolidation of the interests of the Anglo-Mexican Electric Co., Ltd., with those of the Puebla Tramway, Light and Power Co., all the properties of the former company, including its developed water-power plant near the City of Puebla, having been conveyed to the latter company. Under the terms of the consolidation, all the capital necessary for the extension and development of the company's undertaking is provided, and the holders of its shares and securities are to be congratulated upon the arrangement, which, it is considered, will be a very profitable one for the company. Sir Weetman Pearson has been elected president, and Dr. F. S. Pearson will remain on the board of directors for some time, and give the company the benefit of his advice and experience.

Aberdeen Suburban Tramways Co.—The report for the half-year ended July 31st states that the sum standing at the credit of profit and loss account is £1,699. There has been a decrease of revenue of over £250, partly due to the reduction of 2½ per cent. on the commission payable by the Corporation, partly by the severe snowstorm of December, 1906, and partly by the exceptionally bad weather that has been experienced this summer. The directors intend to pursue a policy of economy as far as is consistent with giving the public a good service. They again point out how much the company is handicapped by the excessively high price payable to the Corporation of Aberdeen for electric power. The agreement with the Corporation expires on June 23rd, 1909, and the directors have been considering as to the steps to be taken at the expiry of the agreement. Should the Corporation not make a very substantial reduction on the price at present charged, the company's only course will be to cease taking a supply, and to generate electric power itself. The establishment of a generating station such as is contemplated would involve additional expenditure, and in view of this, the directors recommend that no portion of the balance at the credit of profit and loss account should be meantime distributed as dividend. The directors have every confidence that when a supply of electricity at a moderate charge has been obtained, the company should, with careful management, be able to pay a substantial dividend.

Dublin and Lucan Electric Railway Co.—Mr. W. Mooney presided at the half-yearly meeting last week. He said that the results of the working of the line continued satisfactory. The receipts for the half-year had been £2,897, an increase of £18. The expenditure was greater by £172, principally confined to increased outlay on the permanent way, which was being gradually overhauled from beginning to end. Their large capital payments out of revenue would account for the company's inability to pay a dividend on the ordinary shares now, and would also explain the necessity that had arisen for temporarily overdrawing their bank account. However, they were gradually strengthening the company's financial position, to the shareholders' benefit.

Oldham, Ashton and Hyde Electric Tramway Co., Ltd.—The directors announce the payment of an interim dividend of 2½ per cent.

Electric Landaulet Co., Ltd.—The directors have declared an interim dividend for the first half-year of the current year at the rate of 5 per cent. per annum.

Liverpool District Lighting Co., Ltd. — The directors announce an interim dividend of 2½ per cent. for the half-year ended June 30th.

Chatham and District Light Railways Co., Ltd.—The meeting of this company was held at 83, Cannon Street, E.C., last Friday. The directors' report (see Electrical Review, August 16th, p. 273) was adopted.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	Inc.
Aberdeen	Aug. 21	3,301	+ 58	12	16,970	+ 44	14·4	..
Ayr	„ 24	944	+ 46	15	26,059	— 176	8	..
Bath	„ 21	1,896	— 206	34	26,766	— 993	13	..
Belfast	„ 23	7,199	+ 190	21	77,433	+ 4,892	40	..
Birkenhead	„ 25	2,146	— 71	21	23,459	— 440	13·52	..
Birmingham Corp.	„ 24	12,021	..	21	126,612	..	56·35	..
†Blackburn	„ 21	2,366	+ 262	21⅔	24,024	+ 1,097	14·12	..
Blackpool Corp.	„ 22	6,339	— 182	..	29,680	— 1,902	11·87	..
„ —Fleetw'd.	„ 24	4,235	— 504	7	12,208	— 984	8·25	..
Bolton	„ 25	4,711	+ 60	21	49,071	+ 2,657	26	..
Bournemouth	„ 21	5,021	+ 28	20⅔	27,747	+ 579	21·5	2⅔
Bradford	„ 24	9,532	+ 274	21	99,789	+ 508	52	..
Brighton	„ 25	2,396	— 342	21	20,823	— 2,401	9·5	..
Bristol	„ 23	10,429	+ 49	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	„ 16	436	— 16	32	7,186	— 33	3·65	..
Barnsley	„ 16	424	+ 49	„	5,374	+ 55	..	..
Barrow	„ 16	740	— 34	„	8,286	— 115	5·37	..
Cavehill	„ 16	190	— 53	„	2,777	+ 13	..	..
Devonport	„ 16	1,067	— 80	„	14,736	— 148	8·85	..
Gateshead	„ 16	2,208	+ 147	„	32,444	+ 827	11·25	..
Gravesend	„ 16	681	— 24	„	7,871	— 39	6·5	..
Greenock	„ 16	1,893	— 213	„	21,462	— 331	7·25	..
Hartlepool	„ 16	756	— 23	„	9,283	— 539	6·72	..
Kidderminster	„ 16	484	+ 12	„	3,897	— 149	..	..
Leamington	„ 16	493	+ 2	„	5,133	— 737	8	..
Merthyr	„ 16	497	+ 24	„	6,748	+ 333	2·9	..
‡Metropolitan	„ 16	11,998	+3,435	„	146,596	+39,560	22	..
Middleton	„ 16	816	— 30	„	11,375	— 226	8·5	..
Mid. Joint Com'tee	„ 16	18,886	+ 217	„	185,670	+ 1,975	..	..
Oldham — Ashton	„ 16	1,371	+ 91	„	19,452	+ 917	9·18	..
Peterborough	„ 16	400	— 42	„	4,076	— 210	5·31	..
Potteries	„ 16	3,938	+ 203	„	60,427	+ 1,617	22	..
Rothesay	„ 16	1,177	— 265	„	7,314	— 602	2·75	..
Southport	„ 14	1,018	— 43	„	9,678	— 576	6·17	..
S. Metropolitan	„ 16	2,472	+1,024	„	25,500	..	..	..
Swansea	„ 16	2,563	+ 119	„	28,452	+ 1,036	5·5	..
Tynemouth	„ 16	1,089	+ 26	„	7,974	— 711	3·75	..
Weston-s-Mare	„ 16	1,036	— 66	„	4,349	— 491	8	..
‡Worcester	„ 14	859	— 18	„	9,678	— 265	5·75	..
Wrexham	„ 16	253	— 27	„	3,283	— 62	..	..
Yorks. Wool. Dist.	„ 16	2,056	+ 60	„	30,950	+ 1,398	17	..
Miscellaneous	„ 16	628	— 26	„	7,211	— 175	..	..
Burnley	„ 24	2,623	+ 186	..	..	..	7·5	..
Burton-on-Trent	„ 25	648	— 23	21	6,345	— 324	11	1·5
Bury	„ 18	2,492	..	20	22,421	..	10·5	..
Cardiff	„ 24	4,124	— 201	21	47,327	+ 1,869	15·87	..
Carlisle	„ 24	987	— 33	34	5,865	— 434	..	..
Chatham and Dist.	„ 22	1,616	+ 157	34	24,318	+ 2,112	12·84	2·55
Cork	„ 22	1,047	— 58	34	15,737	— 607	9·89	..
Croydon	„ 23	2,895	— 138	21	30,698	— 1,887	12	·75
Darlington	„ 24	427	— 16	21	4,509	— 51	..	..
Darwen	„ 23	538	— 9	21	5,896	+ 27	4·96	..
Dover	„ 24	624	— 86	21	5,210	— 784	4·75	..
Dublin	„ 23	15,232	+4,058	20	58,312	+14,228	54·25	5·5
Dundee	„ 21	2,297	+ 118	14	16,093	+ 408	13	·5
East Ham	„ 24	1,952	+ 95	21	19,628	— 411	7·75	..
†Exeter	„ 23	740	+ 40	21	7,091	+ 590	4·75	·5
Glasgow	„ 24	34,666	+ 890	12	209,697	+ 2,904	89·75	8
Hastings	„ 22	3,496	..	..	..	..	..	..
Huddersfield	„ 24	3,471	+ 234	21	34,054	+ 1,444	28	..
Hull	„ 24	4,930	+ 362	21	50,542	+ 2,502	13	..
Ilkeston	„ 21	294	+ 12	21	3,061	+ 170	3·5	..
Ipswich	„ 24	1,080	— 61	21	9,131	— 749	10·5	..
Isle of Thanet	„ 24	3,770	— 266	34	21,532	— 855	11	..
Kilmarnock	„ 24	901	— 6	14	2,438	— 39	4·12	..
Lan'kshire Trm. Co.	„ 22	2,646	+ 809	34	39,121	+ 9,612	15·82	3·26
Lancashire United	„ 21	2,896	+ 562	34	42,359	+10,812	38·5	9
Leeds	„ 24	13,147	+ 493	21	139,641	+ 5,704	51·12	6·5
Leicester	„ 24	4,272	— 32	..	..	..	..	..
†Leith	„ 24	1,114	+ 20	14½	8,151	+ 91	6	..
Liverpool	„ 17	25,955	+2,709	33	359,799	+ 7,353	104	..
‡L.C.C.	„ 17	65,526	+12,013	20	626,914	+98,598	117·9	19·9
London United	„ 23	15,458	+1,206	33½	219,804	+ 6,595	..	..
Lowestoft	„ 24	947	+ 24	47	9,108	+ 934	3·5	..
Manchester	„ 24	30,761	+2,298	21	313,109	+23,936	172	20
Newcastle	„ 24	..	..	21	87,394	+ 491	..	..
Newport	„ 24	1,374	+ 28	21	15,341	+ 1,604	14·5	..
Northampton	„ 23	869	— 45	21	9,408	— 474	5·5	..
Oldham	„ 25	4,080	+ 96	22	43,054	+ 2,626	23·75	..
Pontypridd	„ 24	504	+ 172	21	5,614	+ 1,979	5	1·25
Portsmouth	„ 24	5,316	— 262	21	44,843	— 2,271	14·5	..
Preston	„ 14	946	+ 18	..	..	..	..	..
Reading	„ 22	1,347	— 19	20⅔	13,138	— 590	13·25	..
Rotherham	„ 22	1,315	+ 236	20⅔	12,511	+ 1,868	10	·66
Salford	„ 26	9,495	+ 431	21	100,006	+ 2,243	38·9	..
Sheffield	„ 25	11,304	+ 471	22	122,594	+ 5,264	35·75	..
Southampton	„ 21	2,216	+ 65	20⅔	21,637	+ 588	..	..
Southend-on-Sea	„ 21	1,494	— 7	21	9,310	— 367	..	..
Sunderland	„ 4	1,560	— 182	18	26,044	— 272	..	..
Swindon	„ 21	887	— 8	..	..	..	4·4	..
Tyneside	„ 21	970	+ 70	34	15,374	+ 687	8·87	..
Wallasey	„ 24	1,930	— 8	21	18,648	+ 377	8·72	·22
Walthamstow	„ 24	1,378	+ 45	21	13,705	— 157	9	..
West Ham	„ 22	4,480	— 24	21	50,105	+ 1,222	14·7	..
Wolverhampton	„ 21	1,747	+ 14	20	18,177	+ 281	12·5	..
Yorks. W. Riding	„ 25	2,534	+ 785	34	39,062	..	..	..
Baker St.-Waterloo	„ 24	4,080	+1,642	8	18,610	+ 8,183	4·25	1
Cen. London Rly.	„ 24	8,570	—1,385	8	39,456	— 7,206	6	..
Char. +, Ens. Hamp.	„ 24	4,590	..	8	20,365	..	7·75	..
City & S. Lon. Rly.	„ 25	5,874	+1,189	8	24,630	+ 5,260	7·3	1·15
Dublin-Lucan Rly.	„ 24	336	+ 86	8	1,244	+ 73	7	..
G.N. and City Rly.	„ 24	3,994	— 40	8	12,711	+ 136	3·5	..
G.N., P'dy. & Brmp.	„ 24	6,915	..	8	31,475	..	9	..
L'pool Overh'd Rly.	„ 25	3,189	— 2	8	13,893	+ 1,007	5·8	4·8
Mersey Railway	„ 24	3,554	+ 205	8	14,660	+ 1,171	4·5	..
Metropolitan Rly.	„ 25	27,451	+ 706	8	118,200	+ 3,796	24·5	..
Met. District Rly.	„ 25	13,170	+ 189	8	58,815	+ 470	24	..
Anglo-Argentine	„ 26	82,270	+ 2,450	34	543,316	+54,602	43	..
§Auckland	„ 16	10,063	+ 805	22⅔	85,769	+ 3,473	19·2	·56
§Brisbane	July	12,775	+1,617	..	..	..	..	..
§Brit. Columbia Rly.	„	31,176	+9,943	..	..	..	..	..
Calcutta	Aug. 24	6,269	+ 881	..	..	..	..	..
§Cape Electric T. Ld.	May	12,710	..	..	..	..	..	..
§Geneva	July	3,869	+ 781	..	..	..	..	..
§Kalgoorlie, W.A.	July	3,654	..	30	27,406	..	20·5	..
Madras	Aug. 15	1,188	+ 199	32	17,044	+ 2,814	12·75	2·25
§Lisbon	May	806	..	..	..	..	..	..
Perth (W.A.)	Aug. 23	2,578	— 75	34	48,187	— 1,611	25·6	·4

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

August has been such an unsatisfactory month to the world financial that its departure is hailed with a profound sense of relief. Absence of business is too usual a concomitant to the holiday month for its presence to excite protest, but the period has witnessed heavy falls in nearly every market. Now that the Stock Exchange is dealing for September settlements, a brighter aspect of affairs may be discerned, and an unexpected easing of the money market has already made a decided difference to investment securities.

Seven points further fall has reduced the price for Underground Electric Railways profit notes to 56½. The fall has been in course of progress for several months, with hardly a check to relieve it. One view is that the sponsors of the issue are not averse to seeing the price slump, since it gives them an opportunity of buying the Notes at a heavy discount, and so reducing the amount necessary to redeem them when the time for repayment arrives. We merely mention this for what it may be worth.

Tube stocks are quiet enough. One or two sharp rallies have occurred in Home Railway descriptions within the last few days, but they have not got so far as to include the Undergrounds in their sunshine. Metropolitan Ordinary is better at 39½, and District stock at 12.

Much is hoped for in some quarters from next year's Anglo-French Exhibition and Olympic games at Shepherd's Bush, but evidently the speculative investor does not think it worth while to buy Central Londons yet upon the chance of the new venture being a great commercial success.

Traction shares are generally lower. Anglo-Argentine Ordinary continue to fall, and at 8 1/16 are ⅛ lower. Profit-taking sales are put forward as the reason for the steady decline. British Electric Tractions have been flat. The Ordinary gave way 5s. to 2⅜, and the Preference lost ⅛ at 6⅜. It would seem as though the time must be approaching for the usual support to be rendered, unless the buyers have grown tired of upholding a market so irresponsive—for long together—to their assistance. Dublin United Ordinary have been marked down half a sovereign.

As regards the movements in these provincial shares, such as Dublin Trams, for instance, it is a common thing for prices of shares to be left standing unchanged in the Official List for weeks together before somebody happens to notice that the quotation is widely different to the price given in the List of the country Stock Exchange dealing more freely than London does. Directly the discrepancy is observed the London List is altered; no shares change hands and no business is therefore recorded. It is a matter of London being set right by the provinces.

Four prices have been lowered in the Telegraph and Telephone catalogue, but they are of no significance. The easier tone remains noticeable in the Anglo-American Preferred and the Eastern stocks. Anglo-American Deferred are better on the Yankee rise. Globe Preference came slightly on offer, but there is still a demand for the prior-charge stocks of the National Telephone Company. To illustrate the general character of the catalogue, it may be pointed out that out of nearly 60 stocks and shares quoted, only 4 go dividendless.

This record, however, is surpassed by that of the Electric Lighting list. The consideration fails to sustain the prices, the few changes being in the downward direction. Metropolitans fell to 5⅜, and Westminster Ordinary again gave way a similar fraction to 9. South Metropolitan Preference are a little lower. The "City" group keeps its prices, and manufacturing shares connected with the industry are quietly firm. Nor is there any movement worthy of mention amongst other miscellaneous shares.

Fleetwood and Blackpool Tramroad Co.—Mr. G. Richardson presided at the half-yearly meeting held on 22nd inst., when a balance-sheet was presented showing a net profit (after providing for debenture interest) of £4,463. The directors recommended a dividend at the rate of 4 per cent., absorbing £3,000, and a sum of £750 was written off depreciation reserve, and £500 placed to general reserve, leaving a balance to be carried forward of £212. The receipts from all sources amounted to £10,948. This was slightly above the figures for the corresponding half of 1906. The balance-sheet was approved and a dividend declared, as recommended.

China Light and Power Co., Ltd.—The *Anglo-Japanese Gazette* says that the gross profit for the year ended February 28th last was $79,966. After paying interest and other charges, there remained the sum of $46,459, which amount the directors applied to write off as depreciation.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Aug. 20th.	Closing Quotations Aug. 27th.	Business done week ended Aug. 27th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,600	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	61s.	28%	31%	37%	60 — 62	60 — 63	..	..	..	6 3 0
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	105½—106½	105 — 106	105⅝	..	— ⅛	5 13 2
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	½ %	1⅝ %	16¼ — 17	16⅞— 17⅛	17 1/16	16½	+ ⅜	10 1 5
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	7 — 7½	6¾ — 7½ xd	..	..	..	5 10 4
2,097,680	Commercial Cable Sting. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	93¼	92¼	..	4 5 1
16,000	Cuba Telegraph	10	6 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	6 5 0
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15½ — 16½	15⅞ — 16½	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3½ — 3¾	3⅜ — 3½	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	9 — 9¼	..	..	..	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101 xd	..	..	..	4 18 2
60,710	Direct United States Cable	20	8 %	3½%	4½%	4⅝%	14⅜— 15½ and bonus	14⅜— 15½	14¾	..	..	6 7 4
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99½—101½	99½—101½	..	..	..	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	133 —138	132 —137	135	132	—1	5 2 2
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	86 — 88	86 — 88	87½	87½	..	3 19 7
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	..	..	..	3 16 2
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅞— 13⅛	12⅞— 13⅛	13⅛	12⅞	..	5 5 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 —104 xd	102 —104	102⅞	102	..	3 18 11
235,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,900, red. 1909	100	4 %	4 %	4 %	4 %	97⅞—100½ xd	97⅞—100½	..	..	..	3 19 7
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98⅛—100½	98⅛—100½	..	..	..	3 19 7
181,127	Globe Telegraph and Trust	10	5⅛%	5⅛%	5⅛%	5⅛%	10⅝— 11	10⅝— 11	10⅝	10⅝	..	5 0 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13¾— 14	13¾— 14	13¾	13¾	..	4 5 9
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	24 %	24%	20 %	34 — 36	34 — 36	34½	..	..	5 11 1
23,5 28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99½—101½	99½—101½	..	..	..	4 8 8
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	56 — 58	56 — 58	..	..	..	5 19 1
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	66 — 68	66 — 68	..	..	..	5 2 11
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	67 — 69	67 — 69	..	..	..	5 15 11
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞— ⅞	⅞— ⅞	..	..	..	Nil
72,680	Mexico Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	..	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1— 1	1— 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —108	106 —108	106½	106	..	5 11 1
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½%	105 —107 xd	105 —107	106½	105	..	4 18 6
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13 xd	11 — 13	..	..	..	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 1/16— 5 3/16 xd	5⅛— 5⅛	5 5/16	..	— 1/16	4 10 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	96¼	9½	..	3 1 3
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100½—102½	101 —103	102½	101½	+ ½	3 18 1
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6⅛%	6⅛%	7 %	7 %	1½— 1⅝	1½— 1⅝	25/-	..	..	5 1 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..	..	4 11 5
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	91 — 94	91 — 94	..	..	..	4 5 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6¾— 7¼ xd	6¾— 7¼	6¾	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5½	5 — 5½	5	..	..	4 10 11
15,609‡	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	3 16 8
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13 — 13½	13 — 13½	13 3/16	13	..	5 3 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅞— 1	⅞— 1	..	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7⅛— 7¼	7⅛— 7¼	..	..	..	10 5 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6⅛— 7⅛	6⅛— 7⅛	..	..	..	Ni
0,000‡	Do. do. 5% Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 — 102	99 —102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	8 %	8¼— 8⅜	8 — 8¼	8¼	7⅛	— ⅛	4 17 0
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	6 — 6¼	6 — 6¼	6	..	..	4 8 0
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
830,000	Babcock & Wilcox, 1 to 830,000	1	17 %	20 %	20 %	20 %	3¾— 4	3¾— 4	78/9	77/6	..	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1¼— 1⅜	1¼— 1⅜	..	..	..	3 18 10
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	4¾— 5⅛	4¾— 5⅛	5 1/16	..	..	6 13 4
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	5 — 5⅛	5 — 5⅛	..	..	..	6 7 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3⅞— 4⅛	3⅞— 4⅛	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	96 — 99 xd	96 — 99	96½	..	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	127 —132	127 —132	129	..	..	4 10 11
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	110 —114	110 —114	111½	..	..	4 7 9
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	103 —106	103 —106	..	..	..	4 14 4
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	2⅜— 2⅝	2⅜— 2⅝	43/9	..	— ¼	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	6½— 7⅛ xd	6¼— 7	6⅞	6⅝	— ⅛	8 11 5
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	101¼	100	..	4 17 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	78 — 81	78 — 81	79¼	78	..	5 11 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6⅞— 7⅛	6⅞— 7⅛	7⅛	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛ xd	5⅝— 6⅛	6⅛	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 — 104	101 —104	100½	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	87 — 91	87 — 91	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1½	1 — 1½	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 64	59 — 64	..	..	..	6 5 0
50,000	Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅞— 1⅛	⅞— 1⅛	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	½— ⅝	½— ⅝	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref. ..	2	6 %	6 %	6 %	Nil	⅞— 1⅛	⅞— 1⅛	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	88 — 91	88 — 91	..	..	..	4 18 11
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	71 — 74	71 — 74	..	..	..	6 1 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅛ — 4⅜	4⅛ — 4⅜	83/9	82/6	..	3 8 7
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	95/-	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
137,610	Calcutta Trams, 1 to 137,610	5	6 %	8 %	8 %	8 %	7⅜— 8	7⅜— 8	..	..	..	5 0 0
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,380..	5	..	..	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 3/16	..	..	4 8 11
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	102 —106	102 —106	..	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅞— 10⅜	9⅞— 10⅜	10⅛	..	..	7 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	105⅛—107⅛	..	..	..	4 3 4
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	..	1/16— 1/16	1/16— 1/16	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	95 —100 xd	95 —100	..	..	..	4 10 6
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	71 — 73 xd	71 — 75	72	71⅜	..	5 9 7
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	87 — 91 xd	89 — 91	89½	..	..	4 7 11
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	53 — 56	53 — 56	..	..	..	7 2 10
1,180,000	City and South London Railway	Stock	2⅜%	2½%	1⅞%	2½%	44 — 46 xd	44 — 46	45⅝	44⅜	..	4 12 2
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1⅞— 2⅛	1⅞— 2⅛	40/7½	..	..	7 0 4
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	94 — 97	94 — 97	..	..	..	5 3 1

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Aug. 20th.	Closing Quotations Aug. 27th.	Business done week ended Aug. 27th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	6 3 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1¼	1 — 1¼	20/7½	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13½ — 14½ xd	12⅝ — 13⅝	..	..	— ⅛	4 4 3
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅞ — 13⅝ xd	12⅝ — 13⅝	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	N	2½%	4½%	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	9 1 10
17,139	Do. "A" shares, 01—017,139	5	N	2½%	4½%	..	2¼ — 2⅜	2¼ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85	83 — 85	..	..	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	3/16 — 7/16	1/16 — 7/16	5/6	4/-	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95	..	..	..	4 4 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1½ — 2 xd	1½ — 2	..	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10⅜ — 10¾	10⅛ — 10⅝	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	1 2 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11⅛ — 12⅛	11⅛ — 12⅛	12⅛	11⅜	..	6 0 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5 1/32	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105⅛ —107⅛	1 05⅛ —107⅛	105 3/32	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	14⅛ — 15⅛	14⅛ — 15⅛	15 1/16	14⅜	..	6 9 0
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1½%	Nil	Nil	1⅛ — 2	1⅛ — 2	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	1	5 %	5 %	5 %	5 %	6⅞ — 7⅛	7 — 8	..	..	..	5 14 11
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 0 0
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 0 0
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛ xd	..	..	..	5 14 3
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	84 — 88	84 — 88	..	..	..	4 10 11
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/32 — 5/32	3/32 — 5/32	2/6	2/-	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	31/32 — 1 1/32	31/32 — 1 1/32	17/6	..	..	5 2 7
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97 xd	..	..	..	4 10 11
30,000	Peebles (B.) & Co., 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	3¾ — 4	3¾ — 4	..	..	..	7 10 0
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16 — 3/16	1/16 — 3/16	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	¼ — ¼ xd	¼ — ¼	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	31 — 33 xd	31 — 33	31⅛	..	..	5 9 1
150,000	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99½ —102½	99½ —102½	..	..	..	3 18 1
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	62 — 65	55 — 58	63	..	—7	10 8 0
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1¼ — 1⅜	1¼ — 1⅜	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3¾ — 4¼	3¾ — 4¼	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5⅛%	5⅛%	5⅛%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7⅜ — 8⅛ xd	7⅜ — 8⅛	..	..	..	5 17 8
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅜ — 8⅛ xd	7⅜ — 8⅛	..	..	..	3 18 10
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅜ — 3⅝ xd	3⅜ — 3⅝	76/3	..	..	6 9 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅜ — 4⅛ xd	3⅜ — 4⅛	75/-	70/-	..	5 9 1
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¼ — 3⅜	3¼ — 3⅜	68/9	..	..	6 0 0
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	96	..	..	4 1 8
49,436	Chelsea Electricity Supply, Ord.	5	5⅛%	6 %	6 %	4½%	3¼ — 4¼	3¼ — 4¼	..	..	..	5 5 11
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	101½	..	..	4 6 7
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 — 10	9 — 10	9 1/16	..	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10⅜ — 11⅜	10⅜ — 11⅜	..	..	..	5 2 2
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4½ — 5	4½ — 5	..	..	..	4 0 0
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7 — 8	7 — 8	..	..	..	6 5 0
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11½	10½ — 11½	..	..	..	5 5 8
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	94 — 97	94 — 97	94	..	..	4 12 9
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	½ — 1	½ — 1	15/-	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1½ — 2	1½ — 2	..	..	..	7 10 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅞ — 5⅜	4⅞ — 5⅜	..	..	..	5 2 4
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 4 2
21,000	Kensington and Knightsbridge Electric Ord.	5	12½%	12 %	10 %	10 %	8¾ — 9⅛	8¾ — 9⅛	..	..	..	5 8 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜ — 1⅞	1⅜ — 1⅞	..	..	..	6 8 0
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4½ — 5	4⅝ — 5	..	..	..	6 0 0
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	93 — 96	91 — 95	..	..	—1	4 14 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	5⅛ — 6⅛	5⅛ — 6⅛	5⅞	5 1/16	— ⅛	6 8 0
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	95/-	..	..	4 5 9
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 4 1
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — £8	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	6¾ — 7	6¾ — 7	..	..	..	5 14 3
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11 — 12	11 — 12	..	..	..	6 5 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6¾%	7 %	7 %	7 %	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..	5 9 10
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅜ — 8⅜	7⅜ — 8⅜	7⅞	..	..	5 14 3
20,000	Do. do. 7 % Pref. 20,061 to 40,060	5	7 %	7 %	7 %	7 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 14 11
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	86	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	½ — 1⅛	½ — 1⅛	..	..	..	Nil
50,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	6 0 0
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2 — 2¼	2 — 2¼	..	..	..	6 0 0
130,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅜ — ½	⅜ — ½	12/6	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅝ — 1¾	1 1/16 — 1 1/8	23/9	..	— 1/16	5 6 8
200 000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅝ — 2¼	1⅝ — 2¼	..	..	..	11 2 0
85,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 3	2 — 3	..	..	..	8 6 8
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	8¾ — 9⅛ xd	8¾ — 9⅛	..	..	— ⅛	6 6 4
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent., August 15th, 1907.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JULY, 1907.

Compared with the previous month's returns, the electrical export and import business of July exhibits a sharp recovery in value.

Thus the exports for the month, totalling £168,275, are the highest recorded this year, and are some £35,000 in excess of both the previous month's total and the average over the year 1906.

The imports have similarly improved, the total of £151,970, although by no means the highest in the present year, being approximately £19,000 ahead of the June total, and somewhat in excess of the 1906 average.

The re-exports, at £18,640, though slightly below the preceding month in value, are still abnormally high.

The returns are, in fact, of a wholly satisfactory character, more especially as regards the export section. In the latter, electrical and electrically driven machinery, generally prominent items, total together nearly £85,000, and cables at £40,000 are well represented.

The import section does not exhibit any exceptional feature; telephonic material—as usual from Sweden and Belgium—figures at £21,522, and electrical machinery at £42,000 approx.

The abnormal re-export total is composed principally of items under goods, cables, machinery and telephones.

In glancing at the countries with which we do business, judged by earlier returns, our Australian business appears, if anything, to be falling away; otherwise increased business appears to be generally distributed.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material and electric bells.	Electrically-driven machinery	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	798	6,015	164	...	148	10,974	77	90	96	...	38
Germany	670	1,131	43	49	6	522	...	...	139	...	...
Netherlands	34	1,841	738	41	27	216	13	...	...	...	...
Dutch Borneo and Java	21	23	7	52	13	794	...	...	333	...	...
Belgium	147	1,072	89	9	153	242	...	...	1,189	40	20
France	182	150	63	2	3	1,498	130	...	...	...	27
Portugal and Portuguese Africa	23	2	35	...	17	3,864	...	2	166	...	...
Spain...	19	...	15	...	15	271	2	...	...	...	...
Italy, Austro-Hungary, Greece and Roumania...	251	...	145	490	420	402	...	...	...	150	26
Egypt and Tunis	101	302	261	207	...	527	...	...	16	2,347	...
China and Siam	363	481	570	246	48	3,193	49	...	330	322	...
Japan	1,557	3,714	298	310	328	5,341	172	...	...	1,759	...
U.S.A., Philippine Islands and Cuba	268	...	...	53	55	751	113	100	...	...	...
Mexico, Colombia, Venezuela, Ecuador and Peru	61	41	...	17	116	1,339	...	...	12	...	...
Chile	594	328	...	373	118	6,644	97	...	...	868	...
Brazil	3,457	...	96	208	165	5,603	6	...	...	49	...
Argentine and Uruguay	1,062	2,769	119	386	232	4,500	274	11	45	...	...
Channel Isles, Gibraltar and Malta	85	543	150	28	...	94	5	...	34	24	...
British West Africa	18	28	108	...	...	691	8	...	105	...	...
Cape of Good Hope	659	1,009	109	22	143	2,283	27	...	46	196	...
Natal...	2,455	1,543	83	442	79	2,888	64	11	48	1,284	...
Zanzibar, Brit. East Africa and Mauritius ...	...	6	14	6	36	3	4	...	57	34	...
India...	2,293	3,759	969	1,091	1,104	8,130	616	150	10	2,276	...
Burmah	753	94	2	45	6	364	5	...	...	27	...
Ceylon	129	701	58	51	10	14	21	...	26	...	...
Straits Settlements and Fed. Malay States ...	559	86	174	128	31	1,589	80	17	706	380	...
Hong Kong	272	2,504	325	225	133	218	16	11	59	360	...
West Australia	755	...	161	61	117	441	3	...	...	...	...
South Australia	292	56	...	320	23	3,110	17	...	9	...	...
Victoria	557	5,213	...	239	89	2,976	56	...	11	...	...
New South Wales	1,159	235	321	770	8	2,235	442	...	271	1,250	...
Queensland	124	...	...	...	12	410	20	...	...	196	...
Tasmania	...	...	...	...	...	16	...	...	...	...	...
New Zealand	440	542	460	174	65	2,110	140	...	257	2	...
Canada and Newfoundland	75	5,190	187	64	...	...	...	18	174	...	...
British West Indies and British Guiana ...	36	...	...	...	10	3	27	...	37	...	...
Total, £	20,269	39,378	5,764	6,109	3,760	74,250	2,484	410	4,176	11,564	111

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark	76	249	10	15	7	1,143	315	...	7,685	...	...
Germany	402	13,328	2,089	4,250	98	14,441	921	3,900	2,183	...	...
Holland	212	5,171	4,149	11,403	709	1,946	620	3,415	787	1,096	...
Belgium	1,423	3,078	407	1,824	367	9,989	442	1,114	9,717	...	...
France	489	8,992	3,741	849	409	1,590	216	3,892	625	838	...
United States	3,021	6	1,343	300	70	12,760	361	127	525	2,583	...
Italy and Greece	40	72	...	...	...	...	...	...	...	...	...
Total, £	5,663	30,896	11,829	18,641	1,660	41,869	2,875	12,448	21,522	4,517	...

Additional import: New South Wales, electrical machinery, £50.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	6,334	4,867	11	971	45	3,766	162	341	2,093	50	...

Total Exports: £168,275

Total Re-Exports: £18,640

Total Imports: £151,970

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

REVIEWS.

The Progress of Electrical Enterprise. Reprints of Articles from the Engineering Supplement of the "Times." By E. Garcke, M.I.E.E. London: Electrical Press, Ltd. Price 1s. net.

No one is better fitted to write the history of the rise and progress of the electrical industry than Mr. Emile Garcke, whose admirable series of articles published in the *Times* newspaper during last year, are now issued in a form adapted for the general reader.

Mr. Garcke's association with the business from its infancy to the present time, when it has developed into a most important industry in which £340,000,000 capital is invested, enables him to deal with the subject from personal knowledge, and not as a mere compiler of historical data.

The difficulties with which electrical supply in the United Kingdom has had to contend, and the efforts to overcome them, are exhaustively dealt with, Mr. Garcke having personally had much to do in the endeavour to remedy the "inappropriate and ill-timed legislative enactments" that have checked and hampered it from 1882, when, under the auspices of Mr. Joseph Chamberlain, the first Electric Light Act was passed. Between that date and 1888 Mr. Garcke, in association with a committee presided over by Lord Suffield, strove to obtain an amendment of the Act, which resulted in the Act of 1888, extending the period of compulsory purchase by local authorities from 21 to 42 years.

From that time the industry has developed, but as Mr. Garcke points out in his introduction, the progress is "almost insignificant when compared with the theoretical potentialities of the industry," and he adds that "the great advantages to be obtained by the applications of electrical knowledge and inventions are so obvious to the man of science, that nothing but a lack of ordinary enterprise would seem to explain the delay in their adoption."

Mr. Garcke's work may be divided into the historical, political and practical aspects of the electrical industry, and under each of these heads the series of papers affords a valuable guide to the thoughtful consideration of the position and prospects of what may be justly termed a complete revolution in the methods of obtaining power for manufacturing, for traction, for heat, for furnaces, or the warming of dwellings, lighting, and rapid communication by means of the telegraph, telephone and telautograph.

To accomplish so great a revolution—with the contingent changes involved in the re-arrangement and redistribution of industries, the alteration in the domestic habits of the people and the enormous losses involved in changing over from the old systems to the new—necessarily requires time and capital, besides every possible facility in wise legislative control.

In his preface, Mr. Garcke alludes to the marked advance of municipal socialism and legislation of a socialistic character as affecting the electrical industry; while cordially supporting the principle that municipal trading in electricity supply has too frequently shown itself to be opposed to the public interest, we cannot endorse his conclusions as to the cause of the present alleged depression.

No doubt the hostile attitude of local authorities has not only hampered the industry, but has prevented reforms of the laws controlling electrical enterprise, and we believe with him that "the majority of people are realising the dangers of municipal trading," but the Fiscal Reform cry will not remedy the fluctuations in trade, which do not arise from foreign competition, but from the check to electrical enterprise through a restricted supply of capital and consequent decline in the promotion of new schemes and full development of those for which powers have been granted.

Mr. Garcke quotes the President of the Board of Trade as desirous of improving the status of the manufacturer by arranging for a census of production, by amending the patent laws, and by increasing the efficiency of the Consular Service, but if he relies upon Mr. Lloyd-George also to abandon the principle of "buying in the cheapest market" by putting duties upon importations, he reckons without his host.

Mr. Garcke is hopeful of the present time as opportune for a fresh start in the direction of securing the great industrial advantages of electricity, and we quite agree with him in his conclusion that it is impracticable to conduct the business on political lines. Let us have all the freedom possible for the promotion of electrical enterprises by reforming the legislation which has hitherto interfered with it, let us encourage the investment of capital for schemes of electricity supply over wide areas by large power companies, and, above all, educate the public by a comprehensive system of publicity, in which some lessons may be learnt from our American competitors.

The contents of Mr. Garcke's series of papers deal with the two great divisions of the industry, electricity supply and tramways, in both of which sections he has had a large experience.

The historical record of progress is of great interest, and Mr. Garcke selects three periods for instructive comparison, viz., 1885, 1895 and 1905. The first date marked the positive stagnation of the business due to the Electric Lighting Act of 1882; 1895 was a high water mark following upon the Act of 1888, and one may point out that Fiscal Reform was not supposed at that time to be a necessity of the industry, although the Americans and Germans were so much ahead of us, but it is from 1905, following upon the waste of capital in disastrous wars, that the present condition of the business dates.

Mr. Garcke's data as to the grant of provisional orders between 1888 and 1900 are most valuable and suggestive, for, as he points out, no fewer than 342 orders during those 11 years were granted to local authorities and only 123 to companies, with the result that while private undertakers dealt promptly with their powers, a large percentage of the orders taken by the municipalities were allowed to remain dormant, and in many instances have been transferred, after years of unnecessary delay, to private companies, upon more or less onerous terms which must ultimately affect the consumers.

The author's paper upon the London problem has a special interest in the light of recent events. The investigations which have been in progress during the contest for powers in the last few years have opened the eyes of the public to the enormous importance of the Metropolis as a great manufacturing as well as industrial centre, which must be provided with electrical energy on the most advantageous terms. As Mr. Garcke mentions, there are in London 12 local authorities and 14 companies carrying on electric supply undertakings, the total output when he wrote (May 30th, 1906) being some 160,000,000 units realising a revenue of £2,000,000. How to deal with this great problem so as to provide for the production and distribution of the energy economically is not yet solved, and Mr. Garcke's chapter upon a proposed Metropolitan Electricity Board deals with the matter, and is of especial interest.

The scope of electricity supply in London he indicates by a comparison with American cities, which seems to prove, so far as London is concerned, that even now "electricity is in its infancy," for he states that in New York the annual output of electricity is equal to 282 units per head of population, while in London it only amounts to 42 units!

Space forbids our dealing further with Mr. Garcke's excellent series of papers, which should be studied not only by the electrical industry but by every one interested in its development.

Progress is not so rapid and continuous as it might be, and at times it is as disappointing as a mirage in the desert, but as the public realise the boon at their command the industry will reach an oasis and enjoy an unlimited and unrestricted prosperity. We commend Mr. Garcke's book as a most valuable contribution to the literature of the electrical community.

Essais des Machines à Courant Continu et Alternatif. By P. Bourguignon. Paris and Liége: Ch. Béranger. 1907.

We welcome this volume as an important contribution to technical literature. The author gives a clear description of some of the best methods employed for testing dynamos. So many methods have been suggested, that engineers despairing of ever finding time to try to understand them all, have often been forced to invent a method for themselves. The author, therefore, has wisely confined himself to giving descriptions only of the best practical methods. The

book is consequently of a reasonable size, and as the author has taken great care to check all the formulæ given, it can be confidently recommended to electricians.

In the early chapters a description is given of suitable testing platforms and of the various accessories, such as rheostats, required for workshop testing. The data given for the heating of rheostats in air and liquids will be appreciated by the practical engineer. We are glad to see that in the chapter on the characteristic curves of dynamos due stress is laid on the fact that the open-circuit characteristic has both an ascending and a descending branch. To take this into account is often necessary in practice, but it complicates the theory very considerably.

The author discusses carefully the question of the kinetic variation of pressure in electric generators. It is sometimes more important, especially with direct-current machines, to know how the voltage varies with the speed than how it varies with the load. The drop in pressure between no load and full load in two machines may be 10 per cent., but a 3 per cent. variation in the speed of the one may only cause a 3 per cent. variation in the voltage, whilst the same drop in the speed may cause the voltage of the other to fall 30 per cent. The reviewer finds it useful following Boucherot to introduce the notion of the "kinetic factor." This factor can be readily obtained from the curves given by the author, and its value gives us an excellent notion of how the machine will work in practice.

Many of the mechanical and magnetic brakes described and illustrated in Chapter VI are new to us, and are most interesting. With respect to the indirect methods of measuring efficiency, the author considers that the usual modification of the Hopkinson method is the best. In his opinion the efficiencies obtained by the method of "separate losses" have only a conventional value. Clear descriptions, however, are given of the methods used for separating certain of the losses, for instance, by noting the difference in the power required to run the machine with its field excited, and when the exciting current is switched off. He emphasises that the method of test should always be stated when giving results.

The chapter on the methods of finding the wave form of an alternator, and of finding the values of its various harmonics by the resonance method, is one of the best in the book. The ondograph and the Blondel and Duddell oscillographs are described. A complete experimental analysis by Armagnat's method of the E.M.F. wave of a four-pole Labour machine is given. An oscillogram is shown illustrating clearly resonance of the seventeenth harmonic. It is pointed out that graphical methods are quite unsuitable for the accurate analysis of the E.M.F. wave of an alternator.

The elegant method devised by Potier for predetermining the voltage drop of alternators is described; it seems to agree better with experiment than either Eschenburg's or Rothert's method. We doubt whether the simple formula given on page 154 for the counter ampere-turns of the armature is of any great value.

The treatment of the alternating-current transformer is strictly orthodox. The author perhaps lays too much stress on the ageing of the iron in the core. He quotes tests on transformers made before they began working on a supply network, and after they had been working six or seven years. The results are certainly rather alarming, the core loss having apparently increased in some cases by over 100 per cent. The author attributes part of this increase to short circuits in the metal sheets forming the core.

On page 170 the method of separating the hysteresis loss in the core of a transformer by varying the applied pressure, and assuming that Steinmetz's law for the hysteresis loss and the law expressing that the eddy-current loss varies as the square of the applied pressure can be used, is very properly criticised. We do not approve of the other method given by the author, namely, the method of varying the frequency and keeping the induction constant. It would be an exceedingly difficult test to make. The assumption that the eddy-current loss varies as the square of the frequency is in general only a rough approximation. It is stated that the assumptions involved in this method have been completely justified by Jouaust and others; we have referred to Jouaust's classical paper (quoted by the author) on magnetic viscosity, but can find no reference to the method in it, and we fail to see any connection between his experimental results and this test. Possibly the author is thinking of another paper of Jouaust's.

The only type of three-phase transformer shown (p. 172) has the reluctances of the three magnetic circuits different. Junior readers might suppose that this defect was inherent in all types of three-phase transformer.

On p. 189 a table of the ratios of the power that can be got from the direct-current side of a rotary converter to the power that can be obtained from it when it operates as a direct current generator is given. It is not stated how these numbers are obtained. For an infinite number of phases and unity power factor, the ratio is given as 2·34 (p. 189); it should be 2·30. In the line immediately following this table, 83 is a misprint for 85. We think that the author should have mentioned that he assumes that the efficiency of the converter is 100 per cent.

A full description of the practical theory of the induction motor is given. We are pleased that slip is defined as $(\omega-\omega')/\omega$, and that the definition of the leakage factor used by Blondel and Behn-Eschenburg is adopted. The author uses, however, Behrend's coefficients v_1 and v_2, which seem to us to be unnecessary.

In an Appendix the rules for testing dynamos published by the American Institution of Electrical Engineers, the Verband Deutscher Elektrotechniker, &c., are given. A useful comparative table of them is also appended. The proofs have been corrected carefully, but we have noticed a few misprints, p. 19, line 1, Mathiessen for Matthiessen; p. 20, line 3, kilovatts; p. 247, line 4, service; and, curiously enough, there is a misprint in the short table of errata given. Page 2, ligne 21, on this table should be page 2, ligne 1. On p. 246, last line, for—

$$\theta = (237{\cdot}1 + t)\{R_{t+\theta}/R_t - 4\},$$

read

$$\theta = (238{\cdot}1 + t)\{R_{t+\theta}/R_t - 1\}.$$

The symbols and notation adopted by the author are, on the whole, extremely well chosen. We do not approve, however, of η for E.M.F., or of ρ for efficiency (rendement).—A. R.

Continuous-Current Dynamo Design. By H. M. Hobart. London: Whittaker & Co. 1906. Price 7s. 6d. net.

This is a short work of 200 pages, with an appendix and various tables, and is stated by the author to be intended, in the first instance, as an aid to students. For his own purposes, however, the author looks forward to having the material between two covers for convenient reference when engaged in routine designing work.

The treatise, as it stands, owes its inception in part to a series of six articles contributed to *Technics*. With these as a nucleus, the writer developed a series of lecture notes which he employed in connection with some evening classes. These in turn have been exhaustively revised, and the present treatise is the final outcome.

A special feature of the book consists in the introduction of 18 complete dynamo designs, all worked out in detail and tabulated. These tabulated designs are given at the end of the book, while at the end of each chapter a table with blank columns is provided, so that the student can work out and fill in the data with which the chapter has been dealing, and then compare his figures with those in the tables at the end of the book.

The first chapter deals with the electric conducting circuit of the dynamo. Diagrams of present standard armature windings are given, with formulæ for the correct pitch of windings and for their resistance. The author draws attention to the fact that engineers still insist on high full-load efficiencies, although by a slight sacrifice of full-load efficiency a much higher all-round efficiency may be obtained. Contact resistance and permissible current density in brushes are treated, and formulæ are given for calculating the losses and temperature rise of commutators.

The magnetic circuit of the dynamo is next dealt with in the orthodox manner, with which we are all familiar.

On the subject of armature interference, curves are given showing the effects of cross ampere-turns on the armature

and the ampere-turns required in the field winding to overcome these effects.

In the proportioning of dynamos the author takes the armature cross ampere-turns and reactance voltage as the basis, and builds up the design around these values. As in other of the author's works, the theory of commutation is very fully treated. Considerable space is devoted to a comparison of dynamo output coefficients, and formulæ are given for predetermining the total works cost of new designs.

A new and welcome departure consists in a chapter on the application of commutating poles and the design of machines for turbine driving.

A full specification of a turbine-driven direct-current generator is given, and in this we note that the author adopts a reactance voltage of 20, and designs the commutating poles to generate an E.M.F. of 20 in the short-circuited coils, a diverting resistance being provided across the commutating pole winding for purposes of adjustment.

The book concludes with complete tables of figures of the 18 dynamo designs already mentioned. We have no doubt that it will be cordially welcomed by both students and designers.

ELECTRICAL DRIVING IN AMERICAN NEWSPAPER AND PRINTING OFFICES.

By F. B.

In the disastrous fire of 1904, in which practically every newspaper establishment in Baltimore was destroyed, the *Baltimore Sun* was one of the sufferers. Its owners have since erected a building which is devoted entirely to the publication of their newspaper. A free hand was given to the architect and engineer to provide for a building and equipment which might include every accessory which would conduce to the economy of time in the production of the paper, and from the account of the engineering portion of the work described by Mr. Willey in a recent issue of the *Electrical Review*, N.Y., they have every reason to be satisfied with the results of their work.

Competition, which acts as such a powerful stimulus both on railway and steamship companies in the introduction of more rapid means of transit, acts in a similar way on newspaper proprietors, who reckon as an advantage every minute in which their paper is on the streets before those of their competitors.

The introduction of electricity into printing offices has had a very marked influence in expediting the various processes through which the newspaper passes. According to the account above referred to, it is claimed that a 16-page eight-column paper is composed, stereotyed, printed, and delivered to the distributors in a shorter time than is possible in any other office in the country, this result being entirely due to the methods which modern electrically-driven machinery have made possible. Each reporter or editor dictates his copy to a typewriter, and as sheet after sheet is revised, a pneumatic tube takes it to the foreman of the composing-room, where it is set up by electrically-driven type-setters which average 6,000 ems an hour, as compared with the previous record of 5,000 ems in other offices. The forme is then passed on to the bed of an impression moulder driven by a 2½-H.P. motor, thence to the steam tables, where the moisture is partly removed, thence to the circular matrix roaster driven by a ¼-H.P. motor, where the matrix is completely dried. A chute then transfers the matrices to the stereotype room in the basement, where the forme is cast and trimmed by electrically-driven cutting tools. The time occupied for the whole process, including the completion of the forme, the moulding, pressing, drying, casting and locking in position on the machine, is only 8 minutes.

The rotary machines are of the Hoe type, each capable of turning out 25,000 copies an hour. The copies are taken from the press ready cut and folded, and delivered on to an endless conveyor moving at the rate of 100 ft. per minute, and are delivered by means of a vertical conduit to the street floor, where they are removed, counted and distributed to carriers and wagons as fast as the papers emerge from the chute.

Each of the four rotary presses is driven by a 35-H.P. motor; one 7½ and two 5-H.P. motors actuate 23 linotype machines, and other motors are used for auxiliary machinery, such as the stereo foundry, tools, air reservoirs, &c.

An interesting part of the installation is the provision of two air reservoirs, situated in the press room, having a capacity of 134 cb. ft. at a pressure of 80 lb. per sq. in., these being used not only for the pneumatic tube delivery which serves 10 stations, and a side-walk freight elevator, but, what perhaps is more important work, for actuating a pneumatic ink distributor. This distributes ink from a reservoir having a capacity of 3,000 lb. of ink, from which tubes extend to a conduit alongside the ink cylinder of the presses, upon which the ink is spread by the air pressure. The distribution of the ink is regulated by the speed of the press, and the flow is cut off when the press ceases its motion. The whole of the operation is automatic, no attendant being required for inking purposes. The arrangement of the presses side by side allows of one conveyor serving the whole of them, a motor of 5 H.P. being quite sufficient for its operation. The labour-saving devices are such that each rotary is operated by a crew of only two men and a fly-boy.

In a recent issue of the *Journal of Electricity, Power and Gas*, a description is given of the electric lighting and power equipment of the Providence Lithograph Co., which contains some interesting particulars as to the methods of driving the various machines. Data as to the power taken on different outputs is also given which would be useful if the size of impression had also been given. Without this, however, the data is of little use beyond showing how the power required varies with the different outputs. Thus, on a 500-volt circuit a two-colour press took 4·1 amperes at 720 impressions per hour, 4·4 at 900 impressions per hour, 4·5 at 1,000 impressions per hour.

A single colour press which took 3·4 amperes at 1,260 impressions per hour, took 3·7 at 1,440 impressions per hour, and 4·4 at 1,620 impressions per hour.

An interesting feature of the press equipments is a luminous signal which serves as a tell-tale, by means of which the overseer can see if the speed of a press has been reduced beyond that for which he has set it.

The following data as to guillotines or paper-cutters will be found useful:—A 60-in. paper-cutter took 2·1 amperes running the fly-wheel freely, and 6½ amperes on a heavy cut. A 50-in. paper-cutter taking 1·4 amperes running light took 2·4 amperes when cutting stock 36 in. wide by 1¾ in. thick, and 3 amperes for 36 in. by 2¾ in.

The wire-stitching machines, as shown by the illustrations, are individually driven, the motors being of only ⅛th H.P., which is a very small motor for a 500-volt circuit. These machines appear from the illustrations to be driven by a friction pulley running against a large fly-wheel pulley on the machine.

According to the description, the Liability Insurance Inspector pronounces the installation to be the best arranged, most complete and satisfactory of any he has examined. It would appear from this that insurance inspectors are more easily satisfied in Providence than in this country, as it is clear from the illustrations that festoons of wires are allowed to be run in the open air between switches and motors, and starting switch contacts are all exposed, permitting of dangerous shocks being received.

Electric Lighting in Germany.—In a paper by Dr. P. G. Klingenberg, quoted in the *Electrical World*, the author states that the double-tariff system of charging for electrical energy has been extensively adopted in Germany. Practice on the Continent has shown a preference for a supply voltage of 220 for the sake of economy in mains, as in this country, but inquiries have elicited the fact that a large proportion of the German central station engineers are in favour of 110 volts, presumably on account of the advent of the metallic filament lamp. The author, however believes that a 220-volt high-efficiency lamp will be evolved. He has no faith in the arc lamp consuming 2 amperes at 110 volts, considering that the 500-c.p. arc is the smallest that is worth making; and he anticipates that units of very high candle-power—say, 5,000—will be utilised for lighting large areas where traffic is congested.

A NEW METHOD OF WINDING ALTERNATOR COILS.*

THE Oerlikon Co. have recently adopted an improved method of constructing the coils used on armatures with open slots. These coils are formed complete and fully insulated before mounting in the slots, in which they are held, as usual, by

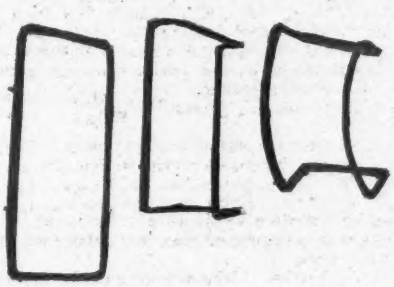


FIG 1.

wedges. Instead of winding them with the ordinary round or rectangular cotton-covered wires, however, bare flat copper strip is used. This strip is bent on formers into its final shape, and arranged so as to lie flat in the slot: *i.e.*, the

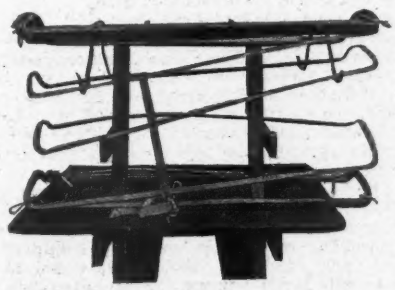


FIG. 2.

width of the strip takes up the whole width of the slot, and the depth of the slot is occupied by a number of layers of the strip. Fig. 1 shows three stages of this bending process. The separate strips are next covered throughout with tape or paper or, in special cases, with micanite, as shown in fig. 2; and finally the completed coil is covered, at the parts which lie in the slots, with a jointless coating of micanite or other

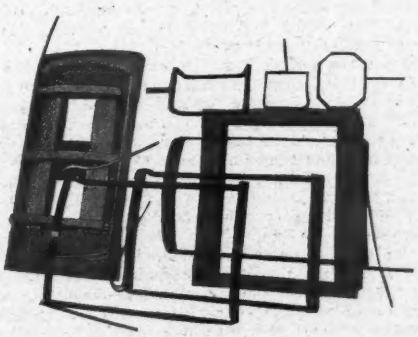


FIG. 3.

insulation. Fig. 3 shows the winding blocks and some coils in various stages of completion. It is claimed for this process that it enables the slot space to be used to the best advantage by reducing the necessary insulation, since the turns only touch at the flat sides, and the voltage difference of only a single turn occurs from layer to layer. The fact that the insulation is put on after the bending is completed prevents all risk of breakdown during formation, and the absence of air-spaces between the turns reduces the likelihood of chemical action occurring at high pressure.

In case of a burn-out, the coil can be readily re-insulated and used again, since it retains its shape even after the insulation is burnt off.

* From the *E. T. Z.*

REVIEW OF THE L.G.B. DEPARTMENTAL COMMITTEE'S REPORT RELATING TO ELECTRICITY SUPPLY UNDERTAKINGS.—III.

Works Accounts, Cost Accounts, &c.

Par. 52.—"Where the operations of local authorities include the construction or carrying out of works by direct labour, it is requisite that *accurate cost accounts should be kept*, and this is especially important in regard to works carried out for private customers.

"In the case of many of the larger authorities cost accounts of a systematic character are kept, while in smaller places works are usually carried out by contract. But the evidence we have obtained seems to show that there must be a *considerable number of authorities* who carry out works by direct labour and yet have *no regular system of cost accounts* in operation; and in these cases any statements of cost that are prepared *must necessarily be of an unreliable character.*"

Par. 53.—"Each cost account should show the materials used (in value, and, if desired, in quantity), the labour employed, the proportion of general charges, and any special or incidental expenditure incurred in respect of the work.

"The allocation of the labour charges will be based upon the wages account and the subsidiary documents from which it is made up. The *proper allocation of these charges is a matter which requires careful and constant supervision*; and, where any large amount of labour is employed, security can be obtained only by the employment of separate recorders of work."

Par. 54.—"Each cost account should be closed when the work is completed, by charging the customers, or the services concerned, with the ascertained cost. The cost of works which are incomplete at the end of the financial year should be described in the balance sheet as 'works in progress.'"

That a great many authorities have no regular system of cost accounts is undoubtedly true, and, therefore, many statements that are prepared must necessarily be of an unreliable character. There is only one reliable system of proving the accuracy of cost work, which we will endeavour to explain as briefly as possible. In the first place, an expenditure account should be opened and debited with the stock in hand at the commencement of the financial year; to this should be added the whole of the purchases, wages paid, petty cash disbursed, postages, and all direct charges such as salaries, interest and repayments, bank interest, &c., in short, all expenditure chargeable against the department. To the credit of this account should be posted the whole details of the debit side of the balance sheet, including the prime cost work, showing each job under its proper allocation and the stock in hand at the end of the financial year to balance. The prime cost may be sub-divided into as much detail as the engineer may consider necessary for the welfare of the undertaking. This is a matter of no moment to the finance department or the Local Government Board, provided facility is given to audit the allocation of the work, but is of extreme importance to the commercial engineer, as it is from this source alone that he is enabled to base his recommendations to his committee for charges for supply.

It has been considered necessary to call special attention to the allocation of labour, and undoubtedly the L.G.B. is justified in so doing. The notorious laxity of engineers in the past with regard to allocation of wages has caused the L.G.B. to take stringent measures in order to induce reform. The action of the Board in endeavouring to make the wages of all permanent workmen a charge upon revenue, has been brought about by the custom of finding work under capital account for men, when there has been no legitimate capital work in progress. Capital should be employed for the purpose of earning revenue, and any creation or accumulation of non-revenue-earning capital is only piling up charges on future generations. We find that the following system answers all the requirements of Par. 53 as regards careful and constant supervision, and is also a deterrent to the practice of engineering assistants, of taking credit for economy by diverting legitimate revenue charges to capital account.

A daily time-sheet is issued to each workman, with spaces for job number, description of work, regular hours and over-time; this is made up by the workman and handed into the time office on cessation of work. These sheets are checked by the timekeeper each morning following, by a comparison of the total time with that recorded, and passed on to the prime cost clerk for the purpose of comparing the description of work with the job number; they are then forwarded to the various engineering assistants responsible for the supervision of the work executed, for the certification of the time charged to the various jobs. By this method there is little chance of collusion, on account of the varied form of supervision; finally the works order, to which the job number gives reference, is allocated by the chief engineer or manager, and passed on to the Borough Accountant or Treasurer for reference during the Government audit of accounts. The analyses of the wages may be made weekly and balanced with the total weekly wages sheet, but for the purpose of balancing at any part of a week, it is preferable to work out the time values and analyse and post to prime cost daily; the seven days cross added should balance with the weekly totals. From these daily analyses sheets a return is made to the chief engineer, properly allocated, who is thus enabled to inquire into any apparent excess expenditure whilst the knowledge is *fresh in the minds of his assistants.*

The mention of "proportion of general charges and any special or incidental expenditure," calls for some explanation, as the meaning is rather obscure. In addition to the two main sources of expenditure, viz., labour and materials from stores, it is often necessary to purchase special materials or employ outside work, which may be allocated direct from invoice or through the medium of a purchases journal, whilst incidental expenses directly chargeable to a particular service can be posted from the petty cash book. In addition to these special and incidental charges, there are a number of accrued charges which cannot be taken from any definite source—viz., storekeepers' and timekeepers' wages, the salaries of officers supervising work, wear and tear of tools, and various items which make up general establishment charges. Should the sum of these items be found to be, say, 10 per cent. of the total wages and materials issued over a given period, then it is proper to debit the prime cost of all capital and re-chargeable work to the extent of 10 per cent. of wages and materials issued from stores, and credit establishment account with the amount. The legitimacy of this charge will be apparent when it is considered that, had not direct labour been employed, it is probable that the contractors would have added considerably more than the ascertained sum for their establishment charges and profit.

We shall be pleased to see the section of the Report relating to works accounts and cost accounts adopted in its entirety, especially as it will settle, once and for all, the much-vexed questions of "employment of permanent workmen on capital work" and the proper allocation of general charges.

METHODS OF SECURING POWER BUSINESS.

It will be granted by most station engineers that electricity supply concerns in America have taken up to the present considerably more trouble to ascertain the scientific conditions underlying the increase of business than we have on this side of the Atlantic. Our energies seem to have been more or less concentrated upon economical production and distribution of electricity, while theirs have been extended to experimenting upon the best means of obtaining greater bulk of business. In the *Western Electrician* of July 6th, appears the summary of a paper under the above title, read by Mr. G. N. Tidd, before the National Electric Lighting Association at Washington. Starting from the proposition that there is no reason why a central station should not furnish all the power used by manufacturers and others in the city, with possibly the exception of those manufacturers who use a large amount of steam and heat in their process of manufacture (*e.g.*, paper mills, who steam their pulp and use their engines simply as reducing valves), the author at once proceeds to enumerate the methods for obtaining the long-hour high power factor class of customer. In passing, a summary of the arguments he uses for a transfer from steam to electric drive are worthy of note:—

1. Private plant generally uses comparatively expensive coal.
2. It incurs high cost of haulage in taking coal in and ash out.
3. It is probably purchasing its water from the city supply and feeding it to the boilers with injectors.
4. The boilers are frequently poorly set, and operating at poor efficiency.
5. The engines are probably of inferior design, old and in poor condition. Usually slide valve or high speed automatic types are used.
6. The engines are in many instances either under or over loaded.
7. The frictional load of shafts and belts will frequently represent 20 to 50 per cent. of the power produced.

As opposed to this, the central station has high efficiency generating plant, methods of burning low grade fuels, saving of power secured by the elimination of a great proportion of frictional line loss due to motor drive, low labour costs owing to the large outputs and labour-saving devices.

The methods for obtaining power business of the right sort are as follows:—

1. Get hold of a good operating engineer as salesman, a man, if possible, who has had charge of a central station plant, and who can appreciate quickly the points which constitute good and bad steam engineering. Give this salesman one or two assistants, and let him devote his entire attention to the work. His varied experience in operation will make this type of man particularly resourceful and valuable for this work.

2. Canvass the district. Make a thorough investigation of every power producing plant in the district, however large or small. Keep a systematic record of every case in a plant data sheet, study thoroughly each power problem, and supplement this with a knowledge of the process of manufacture. This will develop a business which would at first sight appear impracticable. The idea of this preparatory analysis is to put the central station representative in a position to meet the owner or manager upon his own ground with a grasp of the total cost of the plant, conditions of operation, and load factors. Always keep records, as in some instances one cannot tackle the manufacturer until he has a breakdown, and when it comes, all the data should be instantly at hand.

3. Secure a large and representative installation. Break the ice with one large consumer, and others will have more confidence, and will be easier to handle. There are one or more manufacturers in a district who are naturally leaders, and others are very apt to follow suit. Make the most important manufacturer your friend, make his installation a novel one, get his permission to show other people over his works, and, if possible, to have an interview with the manager himself. His word will go a good deal further than that of your representative.

4. Put in a trial demonstration. Some manufacturers are ready to admit that central station drive is good for their neighbours, but are not quite sure that it is so for themselves. In this case take the risk and install a complete equipment and furnish current to operate for 60 or 90 days' trial. Usually the manufacturer will agree to pay a nominal sum representing his acknowledged costs for the service, and in many instances will further agree to provide motor foundations and belts. In addition to the fact that, under these conditions, the expense is nominal, inasmuch as the plant can be used up elsewhere if rejected, the experiment is not so risky as it may seem for the reason that the organisation of the isolated steam plant deteriorates, and sometimes goes altogether, so that it is hard to get another operating staff to run the private plant. The inertia of making the change has been overcome, which is an advantage on finally closing the order. The trial demonstrates a good deal more than talking. The advantages of close regulation, high output, freedom from worry, flexibility and cleanliness, impress the manufacturer, and the test also gives the central station man an accurate determination of the actual amount of power required to drive the plant by his method. It is the experience of the author that fully 95 per cent. of these trial installations were finally made permanent ones.

5. Use liberal means of selling. In many instances it is well to sell plant on the instalment system, allowing one or two years to pay for the installation. Secure yourself by taking a lease on the apparatus and insure it against fire. In some instances install the motor free, if it secures particularly favourable business, increasing the charge per kilowatt-hour in order to cover the cost of the motor. The benefits will be especially appreciated by the small manufacturer, who needs the money in his business, and cannot afford to make the necessary cash outlay for a suitable installation.

6. Avoid cast-iron routine. Every prospective power consumer, especially the large one, must be considered as an individual proposition. Do not try to make your system of rates apply to all cases. Do not run away from any high load-factor business, just because the present cost to your station, with low load-factor, is higher than the competitive figure which you will be called upon to quote. As an indication of the value of high load-factor business, and the prices for which power can be sold, divide the station costs up into readiness to serve and output expenses, then divide the indicated load into the total readiness to serve expense, and the total manufactured current into the output expense; this will give the figures upon which long-hour business can be quoted for.

The author gives special consideration to off-peak business. If the actual operation hours of every prospective customer be analysed, it is interesting to find how much business can be secured on the limited hour basis. Wherever a manufacturer works two shifts, it is usually possible to so arrange the hours that they will avoid the 6 o'clock peak on the ordinary lighting load. For example, flour mills can easily shut down for over-lapping peak hours, founders can get out their iron somewhat earlier during the day, and so on. The object can be obtained by shortening the

dinner hour, starting half an hour earlier in the morning, and shutting down earlier during the winter months. Offer flat rates in connection with this off-peak business. The manufacturer will not pay for labour or wear and tear of machinery simply to waste current. He has a clearly defined number of hours to operate, a maximum production to obtain in these hours, and a definite number of machines to operate. A flat rate limited-hour contract can be drawn which will cover the situation, leaving out everything about horse-power, and simply quoting for a supply of energy to drive a certain number of carefully-defined machines a certain number of hours a day. This contract secures certain classes of men in business who cannot be otherwise obtained. A city in the Western States of America, of 25,000 inhabitants, has now a day load of 1,500 KW., and has on its circuits over 90 per cent. of the total power businesses in the city, the only exceptions being the paper mills. Another plant in a city of 30,000 inhabitants has a day load of 1,000 KW., and is shutting down private plants as fast as station capacity can be increased to take care of the load. Fully 50 per cent. of the power contracts in both these cities are upon the limited hour basis.

THE JUNIOR INSTITUTION OF ENGINEERS.

Summer Visit to Scotland.

Eleven years have elapsed since the Junior Institution of Engineers last visited Scotland. At that time Mr. Archibald Denny, of Dumbarton, was president. Through his valuable influence locally, together with the hearty manner in which he entered personally into all the details, a most interesting and instructive programme of visits was arranged, and a highly enjoyable week was spent socially.

In the preparation of this year's programme, the Institution was fortunate in securing the services as hon. local secretary of Mr. Adam Hunter (past-chairman), who was some months ago promoted to the post of chief engineer to Sir William Arrol & Co. So well were his duties carried out that practically every industry with which busy Clydeside is identified was represented in the series of visits, and from the various social engagements much pleasure was derived. The Windsor Hotel, St. Vincent Street, was made the headquarters for the party.

The proceedings opened on Monday, July 1st, the attendance list comprising the names of members from different parts of the kingdom; the Colonies also had its representative in the person of Mr. Edward Goffe, of Johannesburg; and the occasion was well supported by members at Glasgow and the district. For the morning there were alternative visits to Messrs. Barr & Stroud's range-finder works, and the works of Sir William Arrol & Co. At the former Dr. Archibald Barr and Mr. Harold D. Jackson met the visitors; the instrument which was seen in process of manufacture dates from the year 1888 when Profs. Barr and Stroud were associated on the staff of the Yorkshire College, Leeds. Its principal use is in connection with gunnery. By means of the instrument a single observer may easily determine the distance of any visible object within a radius of from a few hundred up to 20,000 yards or more. In 1892 at the invitation of the Admiralty, the manufacture of the instrument was commenced. A small workshop in Glasgow was started in 1895, but two years later, so greatly had the demand for the instruments increased that another shop had to be built, and for six years these two works were used by the firm. But again by 1903 the development had been such that it was found necessary to extend, and the present manufactory was built at Anniesland on the outskirts of Glasgow. The members were much struck by the way in which the works are planned, and by the well-thought-out system which is apparent in every department. The combination of optical and electrical science is exemplified here to a remarkable degree, for not only do Messrs. Barr & Stroud manufacture the range finders in which the telescope figures prominently, but they also produce the apparatus for communicating to the various gun platforms a record of the distance the target is away, which is effected electrically in a simple manner with absolute precision and exactness.

The members who visited the works of Sir Wm. Arrol & Co. had quite a different experience, for there, under the guidance of Mr. Hunter and his colleagues, they were shown examples of the heaviest description of constructional engineering work. Amongst specially notable structures turned out from the works may be mentioned the Forth Bridge, New Tay Viaduct, Tower Bridge, the new bridges over the Nile at Cairo for the Egyptian Government, and the 150-ton hammer crane erected at the works of Messrs. John Brown and Co. at Clydebank. In Messrs. Arrol's shops electrical driving is generally adopted, and the energy is supplied from the company's own plant.

On the invitation of the Lord Provost and magistrates, the two visiting divisions afterwards met at the Municipal Buildings, where they were entertained to luncheon, Lord Provost Bilsland presiding. A number of Glasgow engineers were also present, including the President of the Institution of Engineers and Shipbuilders in Scotland. Toasts were exchanged, and the reception generally was of a very cordial nature. A photograph of the civic hosts and their guests was taken at the conclusion in the quadrangle.

In the afternoon one group of members were shown over the well laid out and managed Corporation sewage works at Dalmarnock and Messrs. Stewarts & Lloyd's tube works; another visited the works of the North British Locomotive Co.; while the whole body were given the opportunity of seeing the old Newcomen engine at work at Farme Loan Colliery. At the locomotive works, amongst other features of special interest pointed out, was the type of roof construction of the new buildings. The roof is carried on cross girders which rest upon columns with deep concrete foundations, having the upper part grilled with steel joists. It is more stable than the ordinary ridge-roof type, and is better adapted for withstanding the severe racking stresses due to the heavy and high speed electric travelling cranes, of which there is one 90-ton on the upper run-way, and one 30-ton and one 15-ton on the lower run-way of each bay. These cranes, as also the 75-H.P. standard size electric motors in these shops, work on a 500-volt current circuit, the current being supplied from the Glasgow Corporation mains.

Electrical power has also been adopted to a considerable extent at Messrs. Stewarts & Lloyd's works, where tubes of all kinds and dimensions are manufactured, the demand necessitating the employment of two shifts of workmen, for day and night-time respectively.

Discarding the attractions of engineering for the beauties of nature, on the following day, favoured with fine weather, the members took the tour of the Trossacks *vid* Ballock, Loch Lomond, Loch Katrine and Callendar, with a stop at Stirling on the return journey for a look at the historic Castle.

On Wednesday the works of the Clyde Navigation Trustees, the Naval Construction Works of Messrs. Beardmore & Co., and the Corporation Sewage Works at Dalmuir were visited by one section, while another was occupied in viewing the Fairfield Shipbuilding and Engineering Co.'s works and the boiler works of Messrs. Babcock & Wilcox. The Clyde Trustees kindly placed their steam launch *Comet* at the disposal of the Institution, and their chief engineer, Mr. W. M. Alston, acted as cicerone.

After leaving the Broomielaw, the elevating ferry at Stobcross was seen, and disembarking at Merklands Quay, an inspection was made of the cattle lairage. The new Rothesay Dock was then shown, and the fine electric generating station and coal hoists. At Messrs. Beardmore's works the visitors were impressed by the magnitude and completeness of the undertaking, comprising as it does the most modern appliances required in the building and engineering of the highest and heaviest class of naval and merchant steamers, with the greatest efficiency and economy. For example, the ironworkers' shed (900 ft. long by 130 ft. wide) contains a complete equipment of the best machine tools to deal with plates up to 40 ft. long by 7 ft. 6 in. wide and 2 in. thick, with angles and other sections of correspondingly heavy proportions, each machine being driven by its own electric motor, and there are electric overhead travelling cranes. On the west side of the basin has been erected an electric giant 200-ton crane, by which boilers weighing 150 tons can be lifted on board a vessel having a beam of quite 80 ft. The works are operated entirely by electric power, the dynamos being driven by Oechelhauser gas engines of 5,300 B.H.P. collectively. Gas is generated by Duff producers, and, as the residual products are recovered, the sale of these represents a great saving in working expenses.

Those members who went to the Fairfield Works spent an equally interesting time. Established in the year 1834, the works have developed to such an extent that they now occupy an area of 70 acres, and give employment to about 7,000 hands. Many war vessels, mail steamers, cross-channel steamers, yachts, &c., fitted with reciprocating and with turbine engines have been built there. The vessels constructed during the year 1906 aggregated 20,063 tons, and were of 29,383 I.H.P.

In going through the works of Messrs. Babcock & Wilcox, it was observed that the machinery throughout is driven electrically. The possible output is five boilers for every working day of the year, and the popularity of this type of boiler is shown from the circumstance that at the present time some 5½ million H.P. of the land type, and over 1,100,000 H.P. of the marine type are at work. The principle of standardisation has been applied in all directions with most advantageous results. Recently the company have taken up the manufacture of electric cranes; various sizes have been standardised already, and the component parts are being made in quantities on the lines which have proved so successful in the manufacture of boilers. Early development of this new branch of business is evidently anticipated, for a further extension of the crane shop is now in progress.

An excursion to Edinburgh was arranged for Thursday with the object of seeing some of the places of general interest there, including the engineering department of the University, and the Forth Bridge. Prof. T. Hudson Beare, an honorary member of the Institution, met the party at the University and gave a demonstration with some of the principal pieces of apparatus. Lord Rosebery had kindly granted permission for the drive from Edinburgh to South Queensferry to be through Dalmeny Park, but in consequence of the continued downpour of rain it was decided to follow the public highway. On arrival at the bridge the resident engineer, Mr. Turnbull, walked across with the members and indicated to them the features of interest in its construction and maintenance. Some facts elicited were that 55,000 tons of steel, 7,000,000 rivets, and 140,000 cubic yards of masonry were used in its construction, and that the total cost of the bridge was about three millions sterling. About one-third of the structure is painted annually, so that every three years it receives a coat of paint, of which about 50 tons are required.

Friday was devoted to visits to the Singer Sewing Machine Works, the shipbuilding and engineering works of Messrs. John Brown & Co., both at Clydebank; the Lanarkshire Steel Co.'s Works at Motherwell, and Messrs. Yarrow & Co.'s new works at Scotstoun. Perhaps what most interested the visitors at Messrs. Singer's works was the automatic machinery used in the

construction of the shuttles, of which there are 46 different varieties divided into four classes—reciprocating, vibrating, oscillating and rotary. In the machining of each shuttle from 22 to 195 different operations are required. The manufacture of the needles (of which there are produced more than 1¼ millions per week) also brings into application some extremely ingenious machinery.

At Messrs. John Brown's works further opportunity was given for examining the processes incidental to the devices of the naval architect, shipbuilder, and marine engineer. It was here that the *Lusitania* was built and engined, and, quite recently, H.M.S. *Inflexible* was launched. For some years the average output has been 60,000 I.H.P. Some exceptionally heavy tools were seen in the large machine shop. Electricity is used on an extensive scale, not only for lighting the workshops and interiors of ships under construction and the yard generally, but also for the driving of machine tools. There are over 200 motors in use, the power absorbed being about 1,500 H.P. Motors are applied direct to machine punches and shears, plate-bending rolls, plate-straightening rolls, angle cutters, bevelling machines, countersinking drills, planing machines, squeezers, circular saws, tool-grinders, &c. Motors are also used for driving portable drills, pumps and ventilating fans on board ships under construction.

The members saw steel being manufactured by the Siemens open hearth acid process at the Lanarkshire Steel Co.'s Works, the furnaces (of which there are six of 25 tons capacity and six of 50 tons) being heated from gas-producers of the Wilson type, all water-sealed. The works are capable of producing 16,000 tons per month of all sizes of structural and building material, from the smallest to the largest. A large engineering shop for repairs, electrically driven, is equipped with heavy tools for finishing and repairing the heaviest machines required in the manufacturing processes, and there is a well-appointed laboratory and test house, where all the raw material is thoroughly analysed before being used, and where the finished product is also chemically tested. Bending and tensile testing machines are provided for mechanical testing.

The new premises of Messrs. Yarrow & Co. at Scotstoun, which were opened to the visit of the members, cover an area of about 12 acres, and have a river frontage of 784 ft. As our readers know, it is the firm's intention to remove from their works at Poplar and to carry on in Glasgow the same business which has been hitherto carried on at Poplar. Mr. Harold E. Yarrow, who is the Institution's Member of Council representing the Scottish districts, showed the party over, and explained how the works had been planned, keeping in view rapidity, efficiency and economy of construction and facility of management. The works will be driven by electric power by current supplied from the Clyde Valley Power Co., at 400 volts A.C., 25 cycles per second. A feature of interest in the pattern-makers' shop is the method of driving the machinery from a pit formed underneath the floor. A motor fixed there will drive on to various lines of shafting, and belts from these will be carried on to the machines, so that the belts will not in any way interfere with the working of the machines.

In the evening the Institution's Summer Dinner was held at the Windsor Hotel, and was well attended. A number of gentlemen associated with the municipal and industrial interests of Clydeside had been invited, and the evening passed off very successfully. Mr. Frank R. Durham, the senior vice-chairman, presided, and after proposing the loyal toasts, gave "The Lord Provost and Corporation of Glasgow," to which Lord Provost Bilsland replied. Mr. E. Goffe proposed "Clydeside Industries," which was responded to by Mr. W. W. May, of Messrs. Beardmore & Co., and Mr. J. Macfarlane, of the Lanarkshire Steel Co. That of "The Junior Institution of Engineers," proposed by Mr. Donald Matheson, chief engineer to the Caledonian Railway Co., was acknowledged by Mr. Dunbar, and "The Visitors," given by Mr. L. M. G. Ferreira, was replied to by Mr. W. M. Alston, chief engineer to the Clyde Navigation Trustees. "The Ladies" was proposed by Mr. H. G. Ferguson, and acknowledged by Mr. G. E. Lygo; and "Our Honorary Local Secretary," proposed by Mr. E. Eade, was responded to by Mr. Adam Hunter and Mr. A. Knight Croad. To these two gentlemen, as also to the secretary, Mr. W. T. Dunn, presents were made in recognition of their services in connection with the preparation and carrying out of all the arrangements for the meeting.

Thus ended one of the most successful summer gatherings which the Junior Engineers have held, and of which the pleasantest memories will always remain, so great was the kindness experienced.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

18,187. "New or improved means for signalling the approach of tramcars at cross roads where overhead electric wires are employed." G. A. Bailey. August 12th.

18,210. "Improvements in or relating to electrolytic processes and apparatus therefor." J. H. Monge and C. Arzano. August 12th. (Complete.)

18,227. "Improvements in or in connection with holders for electric incandescent lamps." G. Davis. August 12th. (Complete.)

18,243. "Improvements in electric arc lamps." S. Szubert. August 12th. (Complete.)

18,245. "Improvements relating to electrically-driven vehicles." R. B. Ransford. (Compagnie Parisienne des Voitures Électriques (Procédés Krieger, France.) August 12th. (Complete.)

18,251. "Improvements in and relating to electric valves or rectifiers of oscillatory currents." A. Orling and J. B. Palmer. August 12th.

18,259. "Improvements in and relating to electric heating devices." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) August 12th.

18,260. "Improvements in incandescent lamps and method of making the same." G. F. Morrison. (Date applied for under Patents Act, 1901, September 25th, 1906, being date of application in United States.) August 12th. (Complete.)

18,261. "Improvements in and relating to dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 12th.

18,287. "Multiplex telegraph apparatus, the intermittent contact apparatus to be applied to other purposes." B. H. Thorogood. August 13th. (Complete.)

18,288. "Improvements in apparatus for limiting and controlling the supply of electric current." G. C. Fricker. August 13th.

18,295. "Improvements in electrical switch cut-outs applicable to the handle bars or steering wheels of motor-cycles and the like." J. R. Smith and J. L. Blain. August 13th.

18,308. "Improvements in omnibus electric signalling circuits." C. H. Ellison and C. M. Jacobs. August 13th.

18,319. "Improved apparatus for automatically limiting an electric current to a predetermined value." J. O. Girdlestone and J. W. Jones. August 13th. (Complete.)

18,330. "Improvements in and relating to electric heating devices." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 13th.

18,331. "Improvements in and relating to protective devices for electric systems and apparatus." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 13th.

18,332. "Improvements relating to electric telemechanic transmitting and receiving apparatus." J. B. M. P. H. R. d'Ivry. August 13th. (Complete.)

18,346. "Improvements in shade-holders and shades specially applicable for electric incandescent lamps." C. W. Dawson. August 14th.

18,348. "Improved method of making electrodes for electric storage batteries." W. Fennell and W. P. Perry. August 14th.

18,368. "Improvements in telephone systems also applicable for telegraphy." G. B. O. Sleebos. August 14th.

18,369. "Improvements in dynamo-electric machines." J. MacDonald. August 14th.

18,398. "Improvements in the manufacture of steel and in electro-metallurgical induction furnaces for use therein." H. Biewend. (Date applied for under Patents Act, 1901, August 14th, 1906, being date of application in Germany.) August 14th. (Complete.)

18,406. "Improvements in electric switches." J. W. Ewart. August 14th. (Complete.)

18,407. "Telephone call register." A. Ries. August 14th.

18,435. "Improved apparatus for locking and unlocking railway carriage and like doors simultaneously." H. J. Taylor. August 15th.

18,441. "Improvements in connection with electro-magnets." P. Pinckney. August 15th.

18,444. "Improvements relating to marine electrically-controlled steering gear." B. P. Haigh. August 15th.

18,462. "Improvements in means for attaching pig-tails to carbon brushes." M. W. Robertson. August 15th. (Complete.)

18,480. "Process for treating galvanic metal deposits." H. Schmidt. (Date applied for under Patents Act, 1901, September 5th, 1906, being date of application in Germany.) August 15th. (Complete.)

18,498. "Operative system for electric railways." O. Bohm. (Date applied for under Patents Act, 1901, August 18th, 1906, being date of application in Germany.) August 15th. (Complete.)

18,513. "Improved spark arrester for electric arc lamps." W. J. Davy. August 15th. (Complete.)

18,514. "Improvements in and relating to protective devices for electric transmission systems." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 15th.

18,515. "Improvements in protective devices for electric transmission systems." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 15th.

18,537. "Improvements in or connected with electric auto-musical instruments." T. E. R. Phillips. August 16th.

18,571. "Improvements in apparatus for finding true magnetic divergence applicable, also for finding geographical divergence and generally for measuring the intensity ratio of two electric currents." L. D. J. A. Dunoyer. (Date applied for under Patents Act, 1901, August 16th, 1906, being date of application in France.) August 16th. (Complete.)

18,573. "Improved means for working or controlling the illumination of electric lamps or signs." J. Cole. August 16th. (Complete.)

18,582. "Improvements in and relating to protective devices for electric systems." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts, Ges., Germany.) August 16th.

18,634. "Improved terminal device for electric batteries." H. J. Andrew and T. B. Little. August 17th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool price, post free, 9d. (in stamps).

1906.

Safety Cut-Out for Electric Motors and the like. G. Moore and J. H. Hirst. 11,772. May 21st.

Means for Compensating Load Variations in Electrical Installations. J. Y. Johnson. (Felten & Guilleaume Lahmeyerwerke Akt.-Ges.) 11,853a. May 21st. (Date applied for under Rule 5, Patents Rules 1905, May 21st, 1906.)

System of Wireless Telegraphy. J. Gardner. 12,183. May 25th.

Electric Traction Systems. T. L. Johnson. 14,163. June 20th.

Electrical Resistance Furnaces. E. Cornelius and L. Fehn. 14,420 June 23rd.

Fittings for Electric Lamps. A. J. Boult. (R. J. F. S. Baron.) 16,582. July 23rd.

Electrical Harmonic Signalling Systems, Particularly Applicable to Telephone Systems. W. H. Wheatley. (Firm of C. Lorenz.) 16,627. July 23rd.

Apparatus Applicable to Electric Signalling, and Especially Applicable for Use in Fire Alarm Installations. C. L. Walker. 17,272. July 31st.

Electrodes for Use in the Treatment of Gases by Arc Discharges. H. Pauling. 18,600. August 20th.

Holders for Cards being Attached to Electricity, Gas and Water Meters and the like. N. A. Chesterfield. 18,607. August 20th.

Process of Charging Lead-Peroxide-Zinc Storage Batteries. R. Ziegenberg. 20,328. September 12th.